

# DECISION SUPPORT SYSTEMS AND BEYOND

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# DECISION SUPPORT SYSTEMS AND BEYOND

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## I INTRODUCTION



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## I INTRODUCTION

- Decision Support Systems (DSS) are rapidly finding a place in the everyday language and operation of the entire organization. Although many of the concepts and definitions concerning decision support systems are still in a state of flux and are not consistent from one authority to the next, there is a definite core of meaning associated with such systems that will clearly have a significant impact on information-processing suppliers and users.
  - Many products and services are now identified as decision support systems and demand for these products has skyrocketed to the point where they currently comprise approximately 7.5% of all information services. INPUT estimates that expenditures will rise to more than 12% in 1989.
  - End-user computing alternatives and the relative low cost of DSS tools are placing significant power beyond the direct control of the Information Systems (IS) area.
  - Artificial Intelligence (AI) concepts and tools are beginning to emerge that can have a significant impact on how a company conducts its business.
- What are these systems and why are they having so great an impact? This report discusses decision support systems as they are currently defined, forecasts how these products will evolve in the future and reviews the impact of DSS on Information Systems.

## A. REPORT SCOPE AND OBJECTIVES

- This report, a part of the Software Planning segment of the Information Services Program (ISP), examines the rapidly changing field of DSS from a corporate perspective over the next five years.
- Among the many questions that this report attempts to answer are the following:
  - What are the major categories of DSS now, and how will these change during the next five years?
  - As the business environment evolves from automated decision support to automated decision making, and as this automated support spreads to more levels of the corporation, what will be the needs of decision makers?
    - What types of information will be required and from where will they be retrieved?
    - What must IS provide to support the decision-making process?
  - Who will implement the systems and services-specific end-user departments or the Information Systems department? To what extent will each group participate?
  - What expectations are there among users for improvements to existing systems or for replacement systems?
  - To what extent will business-oriented Artificial Intelligence (AI) systems be sought after and will expert- and knowledge-based systems be accepted and commonplace in the typical company?



- What decision processes will be automated and what will be the impact of such automation?
- Another objective of this report is to depict the various delivery modes available for decision support and decision making. To this end, this report will examine:
  - The role of the information center (IC) in the decision support process, and how the IC can bridge the gap between end users and IS departments.
  - The impact of linking mainframe and personal computers, thereby extending companies' decision support capabilities.
- This report will also identify specific decision support application types and examines:
  - The major applications for decision support and how these vary by industry type.
  - New application categories now emerging.
  - Types of industry-specific expert systems evolving over the next five to ten years.
- This report also includes a competitive profile of the DSS market, identifying the current overall competitive structure and the strategies of various vendors.

- This report also includes information on:
  - Decision support products and services just coming into play, and projections of what new products can be expected in the late 1980s.
  - Alternative vehicles for decision support products and services as they evolve during the next several years and how these will affect the IS area.
  - The current and future users of decision support products and services and the purchasing criteria of end users and information systems departments.
  - Current user expenditures for DSS products and services.

## **B. REPORT METHODOLOGY**

- Data for this report was obtained through interviews of both vendors and users of decision support systems. The data gathering consisted of both on-site, mail and telephone interviews with users and vendors representing a broad range of job functions and levels of authority.
- Forecasts provided in this report are based on current dollars. They include an annual adjustment for inflation of 7%.
- Additional information and analysis contained in this report was derived from the following sources:
  - Custom research studies that INPUT has conducted in several of the areas related to or encompassing decision support systems.

- A review of the theoretical and academic literature on the subject.
- A continuing review of trade publications as well as industry and business periodicals.
- Dialogues with DSS specialists.
- Definitions of some of the terms used throughout this report are included in Appendix A.

### C. VENDOR RESEARCH

- The vendor research for this study consisted of 43 separate interviews conducted with 45 individuals in 41 companies.
  - These vendors offer a full range of products and services including:
    - Mainframe software products;
    - Minicomputer software;
    - Personal/microcomputer software;
    - Remote computing services (RCS);
    - Professional services;
    - Turnkey systems.
  - In some instances, the vendors offer a single product or service as their only business "line."

- Vendor personnel interviewed have positions ranging from chairperson to technical product management, as shown in Exhibit I-1.
- The Vendor Questionnaire is included as Appendix B.
- A list of the vendors interviewed during the course of this study is included as Appendix C.

#### D. USER RESEARCH

- The user interviews were conducted with individuals from end-user organizations as well as from information systems areas. The ratio of end users to interviews was approximately 2 to 1.
- The total number of user interviews within industry category is depicted in Exhibit I-2. This exhibit also reflects the number of end-user and IS interviews within the following specific industry categories:
  - . Banking and Finance.
  - . Distribution.
  - . Insurance.
  - . Manufacturing.
  - . Services and Other.
  - . Transportation and Utilities.



## EXHIBIT I-1

### VENDOR INTERVIEW PROFILE BY FUNCTION

COMPANY FUNCTION	INTERVIEWS
Executive Management	4
Finance	2
Marketing Management	16
Product Management/Planning/Development	7
Sales Management	7
Systems/Technology	4
Other	5
Total	45

# EXHIBIT I-2

## USER INTERVIEWS BY INDUSTRY CATEGORY

	BANKING AND FINANCE	DISTRIBUTION	INSURANCE	MANUFACTURING	SERVICES AND OTHERS	TRANSPORTATION AND UTILITIES	TOTAL
Number of Interviews	42	25	14	119	25	28	253
End Users Interviewed	29	16	10	65	19	19	158
IS Personnel Interviewed	13	9	4	54	6	9	95

- The end-user interview profile, distributed by user function and industry sector, is shown in Exhibit I-3.
- . Administration and Services includes the usual administrative functions as well as personnel, legal, quality control, and internal consulting.
- . End-User Data Processing includes individuals with responsibilities for Information Centers and independent user data processing subsidiaries, as well as personnel associated with user decision support organizations. Personnel in this category do not report into the IS area.
- . Executive includes the highest level company executives (president, chairperson, etc.) and those individuals who report directly to that office and are not directly attributable to another, more specific area.
- . Finance and Accounting includes the functions typically ascribed to these areas including budgeting and financial planning and control.
- . Operations and Support includes most of the miscellaneous respondents ranging from individuals in a parts department within a manufacturing company to consultants in a service industry function.
- . Planning is generally composed of all corporate strategic planning functions except for the traditional financial planning and market research functions.
- . Sales and Marketing includes sales administration plus market research, franchising, new business development and merchandising.

## EXHIBIT I-3

END-USER INTERVIEW PROFILE  
BY FUNCTION AND INDUSTRY SECTOR

FUNCTION	INDUSTRY SECTOR (Number of Interviews)						TOTAL
	BANKING AND FINANCE	DISTRIBUTION	INSURANCE	MANUFACTURING	SERVICES AND OTHERS	TRANSPORTATION AND UTILITIES	
Administration and Services	3	1	2	4	1	1	12
End-User Data Processing	1	1	-	8	-	1	11
Executive	3	3	-	2	-	-	8
Finance and Accounting	4	3	2	16	3	4	32
Operations and Support	3	1	1	6	4	3	18
Planning	5	2	-	10	3	2	22
Sales and Marketing	5	3	2	16	6	6	38
Treasury and Economics	5	2	3	3	2	2	17
Total	29	16	10	65	19	19	158



- . Treasury and Economics includes those functions plus tax and investment planning.
- The IS interviews were conducted with senior IS executives, with various functional responsibilities, who expressed some knowledge of the subject matter. IS directors, heads of data centers, managers of decision support, technology specialists and consultants, and information center managers where the IC was part of the IS organizations, were among those interviewed.
- Interviews were held with more than one individual in the selected companies in nearly two-thirds of the cases.
- The User Questionnaire is included as Appendix D.



## II EXECUTIVE SUMMARY





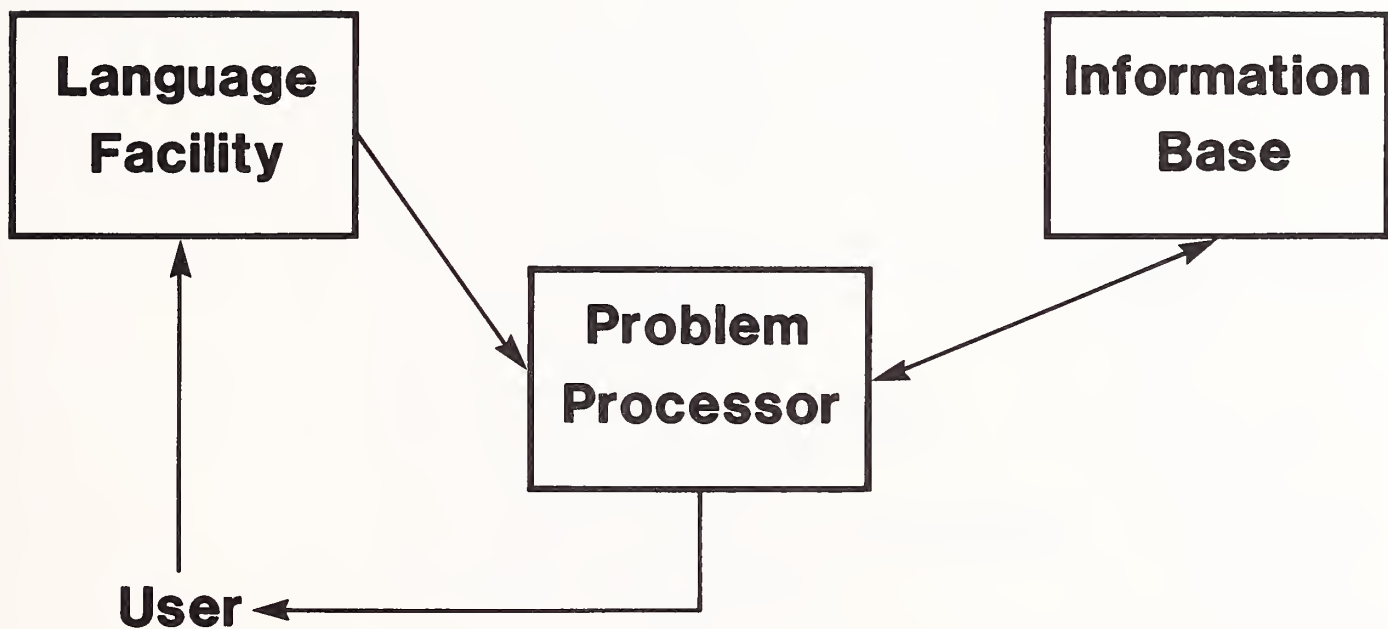
## **II EXECUTIVE SUMMARY**

- This chapter summarizes key forecasts, issues, and trends that are discussed in more detail in the remainder of the report.
- This executive summary is prepared in a presentation format; i.e., the exhibits are set in larger type for ease of use with an overhead projector and the text is in script form. The script for each exhibit is contained on the left-hand page opposite the exhibit.

## A. DECISION SUPPORT SYSTEM COMPONENTS

- The term "decision support" and the many items associated with this concept are appearing on an almost daily basis. While the meaning of DSS varies, most authorities identify a decision support system as being comprised of three discrete components, as shown in Exhibit II-1.
  - The first component is often referred to as the inquiry or language facility. This is the component through which the actual request for execution of the DSS is made.
  - The second major component of a DSS is its information or data base. This is the segment where most of the application-specific knowledge and information is stored.
  - The third segment of a Decision Support System, and indeed its most crucial element, is the problem processor. This segment accepts commands and data from the other two components, processes these and provides the ultimate decision support.

## DECISION SUPPORT SYSTEM COMPONENTS



## B. DECISION SUPPORT PRODUCTS AND SERVICES

- Few products currently on the market provide capabilities in all three components and often they provide for just one. For the purposes of this report, however, INPUT will consider all the products/services such as those listed in Exhibit II-2 as a part of decision support. The tools include the many products that are currently identified as decision support systems, while "Artificial Intelligence" lists some of the items commonly included in AI discussions.





# **DECISION SUPPORT PRODUCTS AND SERVICES**

## **TOOLS**

- Fourth Generation Languages
- Integrated Systems
- Financial Modeling Packages
- Spreadsheets
- Data Base Management Systems (Micro Computers Only)
- Graphics Capabilities
- Inquiry Systems
- Statistical Analysis Facilities
- Forecasting Systems
- Operations Research Capabilities
- Economic Data Bases

## **ARTIFICIAL INTELLIGENCE**

- Natural Language Query Systems
- Expert Systems
- Knowledge-Based Systems
- Robotics
- Vision Systems
- Voice Recognition/Synthesis
- Expert-System Generators
- Specialized Languages (Lisp and Prolog)
- Fifth Generation Computing
- AI Machines



### C. DSS AND NON-DSS SYSTEM CHARACTERISTICS

- These products contain many diverse elements that do not evince any common characteristics. Exhibit II-3 provides a list of characteristics commonly attributed to DSS, and contrasts these against the characteristics usually attributed to the more traditional, non-DSS-type systems.
- For a fuller discussion of the attributes of DSS, the reader is referred to the earlier INPUT report Improving Management Effectiveness Through Decision Support Systems, September 1981.

## DSS AND NON-DSS SYSTEM CHARACTERISTICS

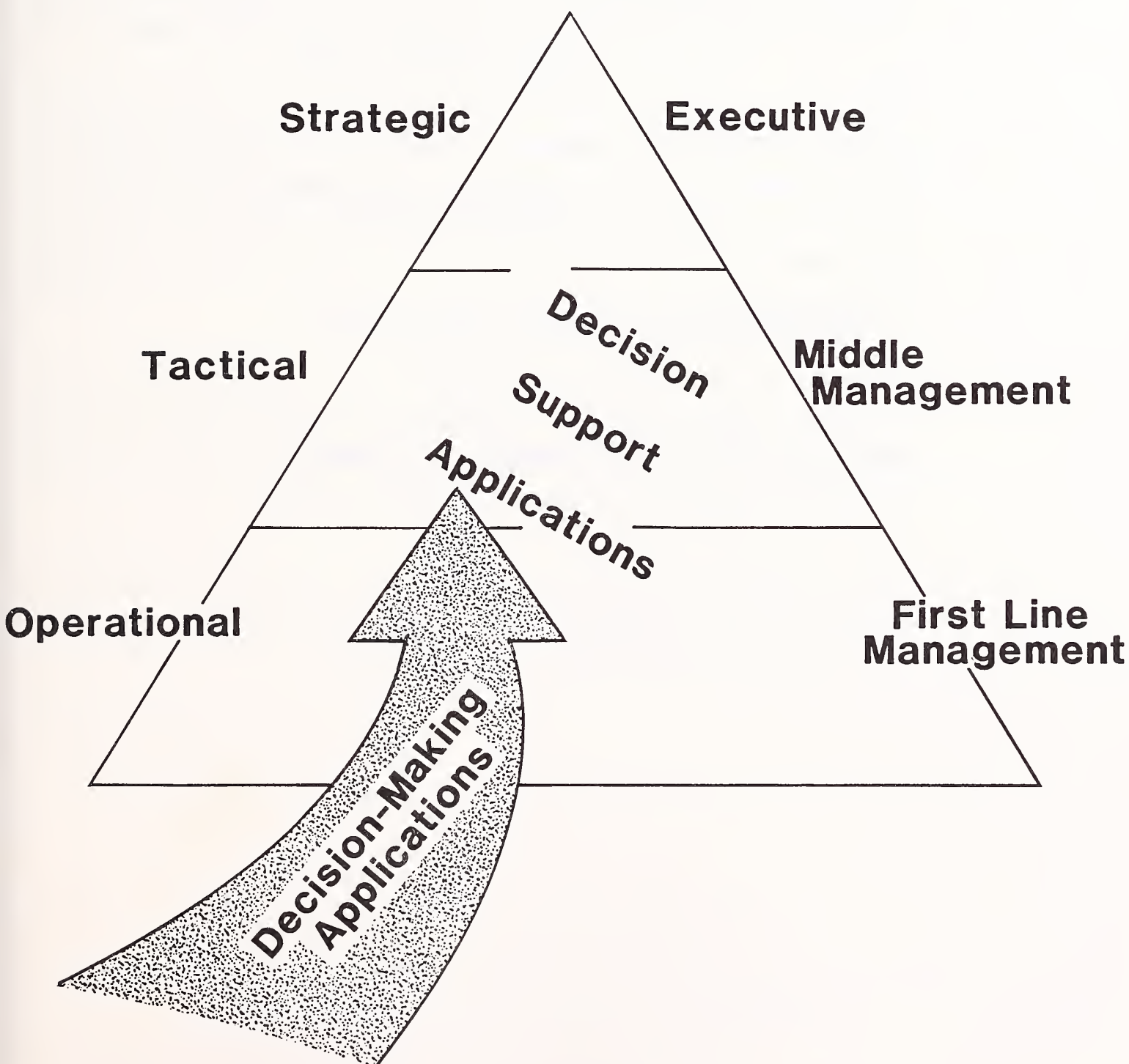
CHARACTERISTIC	DECISION SUPPORT SYSTEM	NON-DSS
System Invocation Level	Predominantly Middle & Executive Management	First Line Management or Clerical
Ultimate End User	Management (All Levels)	Operations & Clerical Support Personnel
System Life Cycle	Short	Medium to Long Four to Seven Years
Program Maintenance Requirements	Seldom Modified	Modified on a Regular Basis
Frequency of Use	As Little as Once	Usually Repetitively
Package Utilization	Packages Used as Tools to Provide Application-Specific Functions	Packages Can Provide Full System Functionality Except for Transaction Data
Data Required	Typically in High Volumes from Multiple Sources Both Internal and External to a Company	Typically Centralized Within a Specific Job Function

#### D. TODAY'S DECISION-MAKING ENVIRONMENT

- Management literature is rife with speculation on exactly how computerization will affect the corporate culture. Some suggest logic and information will replace "seat-of-the-pants" intuition. Others believe a cold, mechanical culture will take root, with computer-based decision making taking place at many levels throughout the organization, including at the top. In any event, there is already evidence that corporations are evolving from a decision support system environment to an environment of decision-making systems, where decision making, particularly in operations areas, will increasingly shift to computer-based systems.
- However, the results of this study clearly demonstrate that such an Orwellian world is not as near as some people predict. While decision support tools, artificial intelligence machines, expert systems and all products associated with DSS are rapidly appearing in many areas, computers are not yet ready to take over from man as the ultimate decision maker.
- While there are numerous examples of computerized decision making at the lower, operational levels of organizations, intuition will remain the prevalent means of decision making at the executive level for the foreseeable future.
  - Decision making via automation/computerization is reaching higher into organizations, as shown in Exhibit II-4.
  - This exhibit also reflects the fact that computerized decision support currently exists at all organizational levels in a typical company.



## TODAY'S DECISION-MAKING ENVIRONMENT





## E. USER DSS REQUIREMENTS

- A significant problem exists in trying to identify the overall decision support system requirements from a user perspective.
- One requirement that is apparent and clearly required by end users is that decision support products must be "user friendly". The influx of personal computers into the corporate office environment has driven end users to seek easy-to-use tools that are the key requirements of future DSS products.
- Users are also seeking to reduce the amount of time required to solve their problems and fulfill their requirements. The traditional systems development and maintenance "backlog" in many companies can effectively preclude development of required DSS applications since many of these affect the near future and are more oriented toward problem-solving than they are to ongoing operational support.
- The nature of DSS applications development is also changing, particularly as the DSS user base expands. It is also evident that as the variety of users of DSS increase, the types of DSS applications developed and their horizontal movement throughout company operations will also change.
- Users do require applications that will reduce the number of operational decisions that senior management must make, thus allowing senior management more time to decide proper strategic direction.

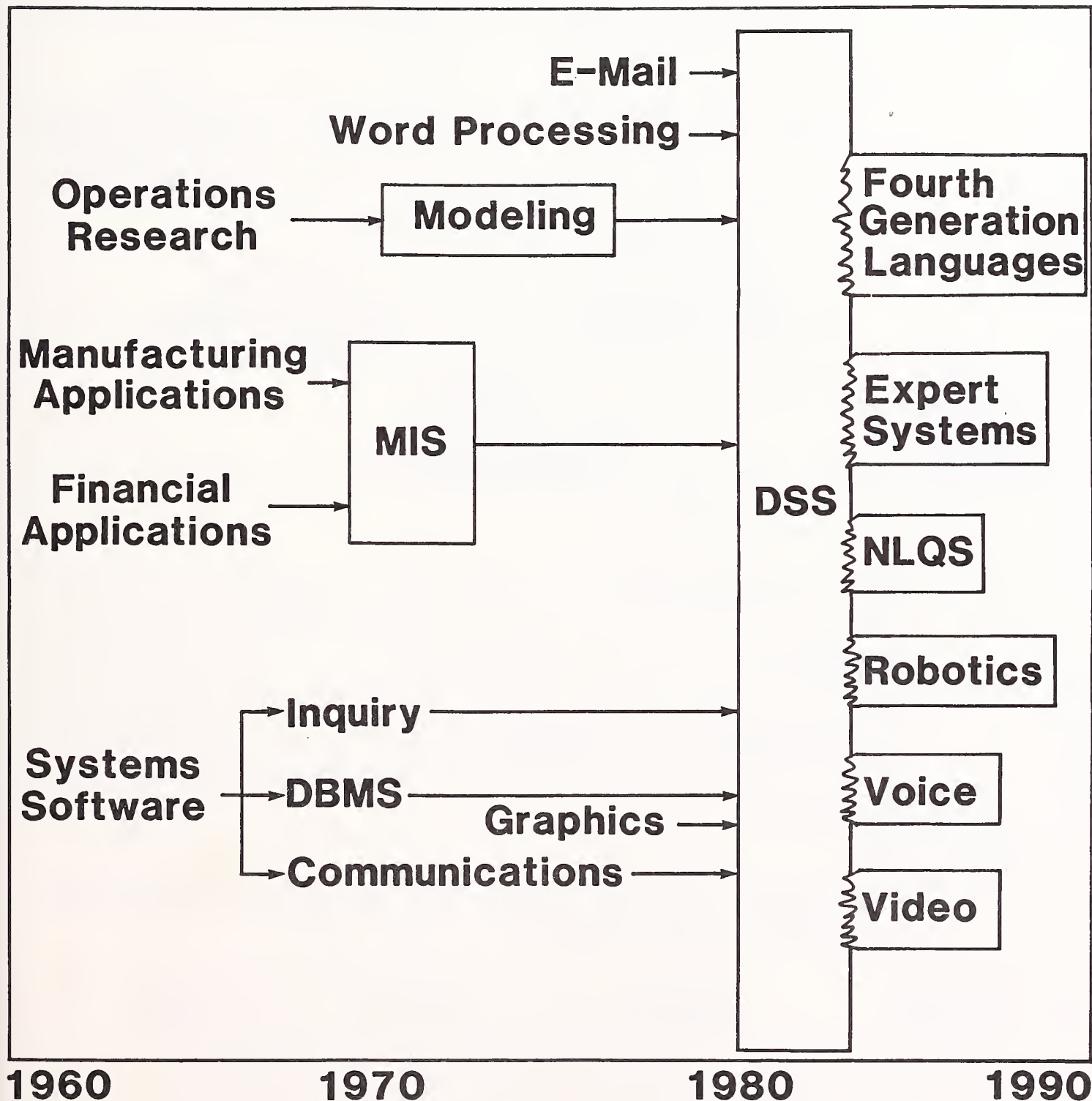
## **USER DSS REQUIREMENTS**

- **User Friendly**
- **Time Savers**
- **Changing Application Base**
- **Reduce Operational Decisions**

## F. EVOLUTION OF DSS SOFTWARE

- One of the main current means of providing decision support capabilities to companies is from Remote Computer Services (RCS) vendors, who often provide sophisticated modeling capabilities.
- However, the phenomenon of end-user computing and the advent of personal computers have begun to dramatically shift the focus to in-house resource.
  - RCS vendors currently provide much of the pure, "number crunching" types of applications associated with first stage maturity DSS.
  - However, the technological advances in hardware and software have allowed transfer of many DSS applications from RCS firms to in-house mainframe, mini- and microcomputers, including standalone PCs.
- Software available from many vendors is replacing RCS as the primary DSS vehicle.
  - The current main trends in software have been to develop more fully integrated packages that provide full numeric functions coupled with text or word processing. However, while more "integrated systems" are appearing, and many vendors are adding functional capabilities to their products, the user is becoming smarter and more sophisticated in software acquisition and is not purchasing one product in preference to another simply because it has a greater number of capabilities than the original. In fact, many users who have traded up to a more fully integrated system have expressed a desire to return to an earlier system, simply because the earlier version was much less complex.
  - Indeed, the trend indicates that the future of the software arena is in system differentiation rather than product integration. As can be seen from Exhibit II-6, the trends show the industry evolving into more specialized products following an era of system integration.

# EVOLUTION OF DSS SOFTWARE

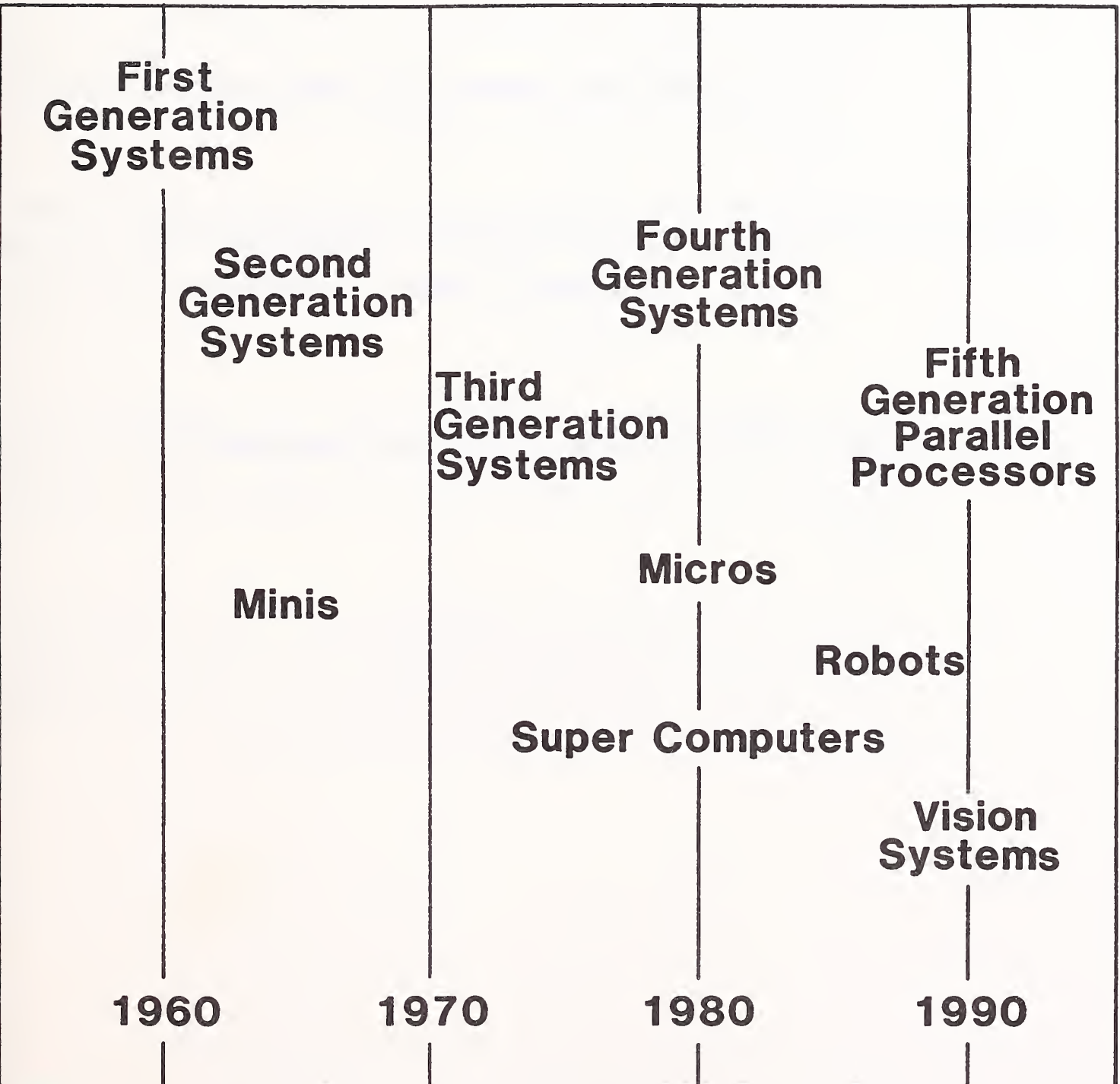


## G. COMPUTER HARDWARE EVOLUTION

- Technology will continue to provide new resources and facilities that will outstrip ability to use such advances.
  - "Fifth generation machines" are being widely discussed when we have really just entered the fourth generation.
  - Researchers say that developments in "parallel processors" will be much more significant than developments in earlier generations of electronic data processing equipment. However, such technological developments have been slow in forthcoming.
  - In only a few short years, over five million personal computers have been installed in corporations, with end users now becoming a much more dominant data processing force.
  - The evolution in hardware corresponding to the software evolution is shown in Exhibit II-7.
- Indeed, hardware advances have triggered the whole surge in data processing. Where previously only a relatively few people could actually program a computer, today's children are learning how to use computers at the very beginning of their schooling. The era is just beginning when people familiar with, and able to use, computers are entering the ranks of senior management in large companies. Few are willing to predict the ultimate results of such developments.
- Technology has also begun to deliver such novel products as voice synthesis/recognition and vision systems.



# COMPUTER HARDWARE EVOLUTION





## H. PROVIDE A CORPORATE FRAMEWORK FOR DSS

- Some of the main recommendations concerning decision support within corporations are listed in Exhibit II-8.
- The primary recommendation is that the corporation should be prepared for the forces of automated decision support and end-user computing.
  - The dramatic changes evident over the past few years will continue to take place in more and more companies.
  - As part of this framework, formal IS strategic plans should be developed to help reduce elements of risk and redundancy. Such plans and the resulting implementation of their specifics should be closely monitored by IS management.
- However, unless the corporation decides to be on the leading edge of technology, caution should be exercised in the acquisition of innovative high technology products since they may either be rapidly improved or become obsolete.
- Another main recommendation involves dissemination of information concerning automated decision support throughout the corporation. This education will facilitate identification and implementation of the high payback applications that will be of most benefit to the corporation.

## **PROVIDE A CORPORATE FRAMEWORK FOR DSS**

- **Develop Strategic IS Plans**
- **Approach Acquisition of High Technology Products With Caution**
- **Disseminate DSS Information in Company**

## I. PROVIDE SOLUTIONS NOT TOOLS

- Robots and robotics have been discussed for many years and have recently found application in a number of highly specialized markets. However, broad-based use of leading-edge technology products is not apparent at this time. Robots, for example, are being used, but they generally appear not to be cost-justifiable except for limited applications.
- Furthermore, many industry experts, leading vendors, and most end-users (including respondents to this survey), believe that significant technological advances will have to be made in the hardware arena before any significant advances toward artificial intelligence can be realized, except in highly specialized markets.
- The IS organization must also provide for the acquisition, maintenance, accessibility and integrity of corporate data. A decision support system can only be of benefit if it uses accurate data.
- Finally, IS must ensure that overall solutions, not just the tools to work with, are provided. In order for an end user to make an appropriate decision, a fully integrated facility providing hardware, software, data, and the means to coalesce these must be available.

## **PROVIDE SOLUTIONS NOT TOOLS**

- **Identify High Payback Applications**
- **Monitor Industry Trends and Developments**
- **Establish Data Resources**
- **Integrate Hardware, Software, and Data**



### **III USER PROFILE AND ANALYSIS**





### III USER PROFILE AND ANALYSIS

#### A. CURRENT DECISION-MAKING ENVIRONMENT

In order to understand the potential uses of decision support products and services, the decision-making process within corporations and the types of decisions made at the various organization levels must be examined. The three primary types of decisions made within corporations are:

- Operational decisions.
  - Tactical decisions.
  - Strategic decisions.
- Operational decisions deal with the day-to-day running of the business. These decisions range from determining the number of nuts and bolts to purchase, to analyzing the qualifications of a new job applicant.
  - Tactical decisions span somewhat longer timeframes and deal with problems and tasks necessary to accomplish corporate business plans and annual financial objectives. An example of a tactical decision would be deciding whether or not to build a new plant or to acquire a company which already has manufacturing facilities in place. Another example would be whether or not to raise prices on a product.

- Strategic decisions deal with answering questions related to the overall objectives of a corporation and its long-term direction. Strategic decision making is typically more intuitive than it is quantitative, thereby complicating any attempts to provide standard solutions. An example of a strategic decision is determining whether or not to enter a new line of business or to leave one already in place.
- We must also consider the main types of data processing systems that currently support most businesses and include:
  - Transaction processing systems. These systems:
    - Comprise the bulk of traditional data processing systems.
    - Usually are operational on centralized corporate hardware or decentralized departmental hardware.
    - Are traditionally developed (or purchased) and maintained by an in-house DP/MIS group.
    - Usually have high input and/or output data volumes.
    - Handle predefined tasks with strict decision rules and logical transaction flows.
    - Produce efficiencies at the operational organizational levels, alleviating clerical tasks.
    - Answer standard/mechanical/rote questions.

- Information retrieval systems. These types of systems:
  - . Answer inquiries which are typically unstructured or unanticipated.
  - . Usually result in the generation of nonrepetitive reports, typically in low volumes.
  - . Provide better "macro level" information to decision makers.
  - . Would often be found in a company with a distributed processing environment.
  - . May also be found in a traditional Information Center environment.
  - . Are also usually developed or purchased and maintained by the in-house group.
  - . Are often mistaken for a decision support system.
- Decision support systems. These systems:
  - . Are beginning to support the manager or executive who makes the decisions.
  - . Often involve a "modeling" program/facility.
  - . Are oriented to predict future events or cycles based on historic trends.
  - . Usually have facilities that support ad hoc data acquisition and analysis.

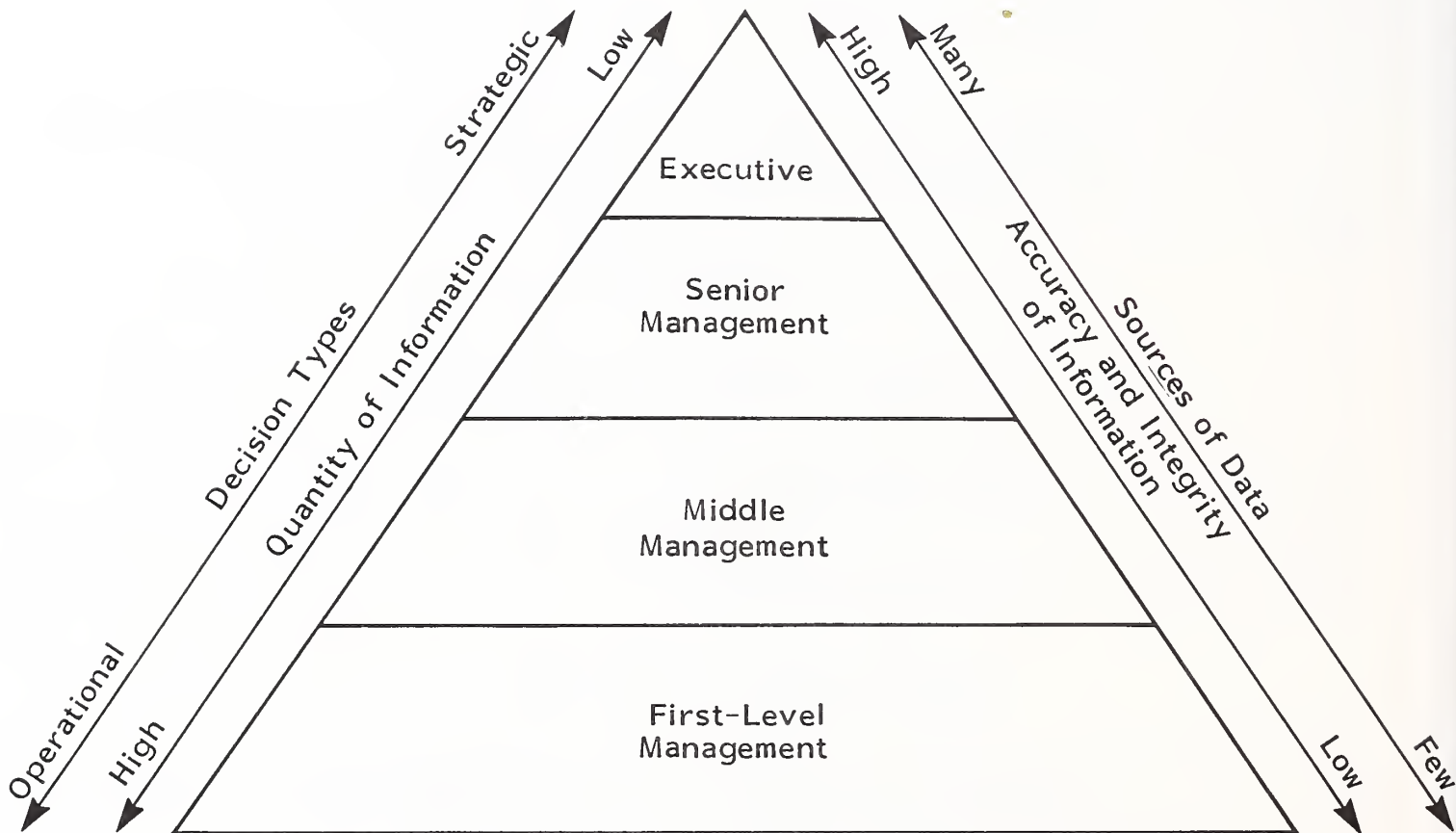
- . Are not used on a predefined, scheduled basis.
  - . Are almost always highly unique by application.
  - . Often involve substantial computation with a significant amount of data retrieved from a variety of sources both internal and external to an organization.
  - . Are often controlled by end users.
  - . Have historically often been provided by remote computer services (RCS) vendors.
  - . Are now often associated with personal computers.
- With this background as the baseline for INPUT's definition of a DSS, let us more fully examine how decision support systems differ from more traditional types of systems. Data is a key factor in the uniqueness of decision support systems.
    - A DSS is very data sensitive since it often utilizes live, current data or auditable historical data. Without precise data, a DSS merely states the possibility of interesting relationships occurring without regard to the true, current environment.
    - A DSS rarely requires new data to be generated. It often requires a set of parameters or boundaries, however, to define the scope of its analysis.
    - Data must often be obtained from external sources to provide information on competitors, external economic conditions, credit histories, etc.

- Decision support systems have evolved from typical operations research functions. Original DSS applications involved high-level mathematical models developed by individuals with advanced academic credentials in management science.
  - DSS then evolved into the financial spreadsheet systems that are often associated with DSS.
  - Decision support systems are now perceived as applications that have been developed with, and include, such diverse software as:
    - Fourth generation languages.
    - Data base management systems (DBMS).
    - Query languages.
    - Expert systems (ES).
    - Natural language query systems.
  - Subsequent sections of this report will examine, in greater depth, these various facilities associated with DSS.
- Data is also important in relation to DSS since significantly more detailed information is required at the lower levels of an organization. Exhibit III-1 shows a typical organizational pyramid with the associated information needs. As can be seen from this exhibit, less information is needed as one ascends in an organization. However, the need for this information to be highly accurate increases, and becomes a more compelling factor than data volume.



## EXHIBIT III-1

### INFORMATION NEEDS BY MANAGEMENT LEVELS



- First-level management is traditionally interested in much higher volumes of information than senior and executive management. Decisions made at the lower levels are typically based on data from fewer sources.
- Higher levels of data accuracy and integrity are necessary in making strategic decisions at executive management levels than in short-term operational decision making. The fundamental data upon which strategic decisions are often based is generated at the lowest levels of an organization and must have the same high levels of accuracy, reliability, and integrity.
- First- and middle-management levels focus mainly on the day-to-day operational concerns of a business. Traditional transaction-processing and management information systems (MIS) are predominant at these levels.
  - These systems support the everyday operation of the business and their overall reliability is vital for managing the business.
  - Outputs of these systems help address operating efficiencies, but their impact points are often in the near future.
  - Many of these systems utilize decision support software (i.e., graphics, data base management systems, query languages, etc.), although they do not contain all the elements of full decision support systems.
- First-level management's focus is traditionally centered on very finite objectives. The field of vision at this level is on specific job functions, such as cost accounting for a particular product and/or component. The information required to support this level of management is usually supplied by a company's transaction-processing systems.
- Operational-level decisions often made by first-level management require less analytical support and more data-retrieval support. Some tools useful in this area include data base management systems such as IDMS/R and ORACLE, and retrieval vehicles such as FOCUS, RAMIS, NOMAD, and IDEAL.

- Middle-management levels deal with tactical as well as operational decisions. The tactical decision-making process has been, and continues to be supported by information-retrieval systems that can cull specific pieces of information from large volumes of data. These systems are often mistakenly defined as decision support systems, when, in fact, they use DSS tools that are merely components of a much more complex system network.
- Of the three primary types of decision making, DSS is currently employed mainly for tactical decisions that tend to be more quantitative and analytical in nature. These decisions lend themselves to support by current DSS offerings. Common tactical decisions can be made by utilizing spreadsheets and modeling languages. Typical applications are performing financial analysis for acquisitions planning, equipment purchases, and new product investments (return on investment, cash flow, lease/buy analysis, etc.).
- Senior and executive management are mostly concerned with strategic issues and usually have broader views that transcend traditional functional lines. The high quality information these executives demand is generated by their staff and/or subordinates, who manipulate and enhance information derived from vast internal and external data sources. The executive analyzes this distilled, high-quality information and delegates actions that guide the strategic direction of the organization.
- It is incorrect to correlate a decision type directly to a specific management level, since many managers are involved in all three decision-making categories.
  - Sixty-one percent of the users interviewed in this study indicated that they made more than one type of decision, and 49% were involved in all three types of decisions.

- Of the users interviewed for this study, 85% indicated that they make strategic decisions, 73% make tactical decisions, and 65% make operational decisions.
- Although decision support tools are currently widely used in the middle-management area in support of tactical decisions, applications of full decision support systems are less frequent at every level and, when utilized, the accuracy of such systems is often questioned.
- Advances in technology are forcing senior management to make more strategic decisions in much shorter timeframes. Often these decisions must be made without accurate, concise information. Many companies are therefore targeting the strategic decision maker as the key person whose decision-making support should be improved.
- Improvements in strategic decision making can have a greater impact on the corporation than productivity improvements at lower organizational levels, since the impact of strategic decisions is usually much broader.
- The proliferation of transaction-processing and information-retrieval systems within many companies has so significantly improved operational productivity that only marginal returns can be expected for further technological enhancements at the operational level.
- However, the overall decision support of these high-level executives currently consists mostly of:
  - . Support staff.
  - . Meetings.
  - . Heavily "filtered" reports.
  - . Telephone calls.



- There have been numerous attempts to improve the executives' productivity by changing some of the above factors. For example, phone call screening, electronic mailboxes, and video conferencing have all had some successes, but none has made the significant inroads necessary to improve executive productivity drastically.
- However, computerization at the appropriate levels can help the senior executive alter his normal work patterns and thereby increase his overall productivity.
- At senior and executive management levels, fear of technology still exists that hampers use of automated support, but the dramatic growth in popularity and use of personal computers is alleviating some of this fear. This reduced trepidation will facilitate bringing decision support systems to senior and executive management levels.
  - This continues to be a challenge to the control of IS as a provider of data processing services within the corporation.
  - Furthermore the proliferation of PCs and the phenomenon of end-user computing could cause significant problems to IS managers if such developments are not closely monitored.
- A further problem with strategic decision making is that it is more intuitive than it is quantitative, and current decision support tools and software provide little support for intuitive decision making. Some success has recently been achieved, however, in the area of "knowledge-based" or "expert" systems, which will be discussed later in this report.
- Strategic decisions are often based on information derived from high volumes of data captured by a company's basic transaction-processing systems, including such systems as accounts payable, accounts receivable, order entry, etc.



- DSS tools, including data base management systems, high-level languages, and inquiry facilities, are beginning to provide senior and executive-level management with some decision support, but most of these tools will not reduce the executives' "technophobias" since these tools are often not user-friendly and require considerable assistance from IS personnel for proper use.
- Natural language query systems and voice recognition, developed as a part of artificial intelligence research, are emerging that will provide more support for executive decision making.

## **B. USER DSS PERSPECTIVES**

- User interpretations of decision support resulting from study surveys can be examined, using this basic decision-making environment as a frame of reference.
- Exhibits III-2, III-3, and III-4 show percentages of surveyed users for the three types of decisions, by job category (end user or IS) and by industry. As can be seen from these charts, the representative sample of users in this study includes a high percentage of people who make strategic decisions. These are the people whose decision-making productivity is the ultimate target for improvement in most companies.
- How decisions are made is as important as the different types of decision. Allowing for the fact that most people make decisions in a variety of ways, Exhibit III-5 shows us that people generally rely on others when arriving at decisions.

EXHIBIT III-2

INTERVIEW RESPONDENTS BY INDUSTRY  
- STRATEGIC DECISIONS

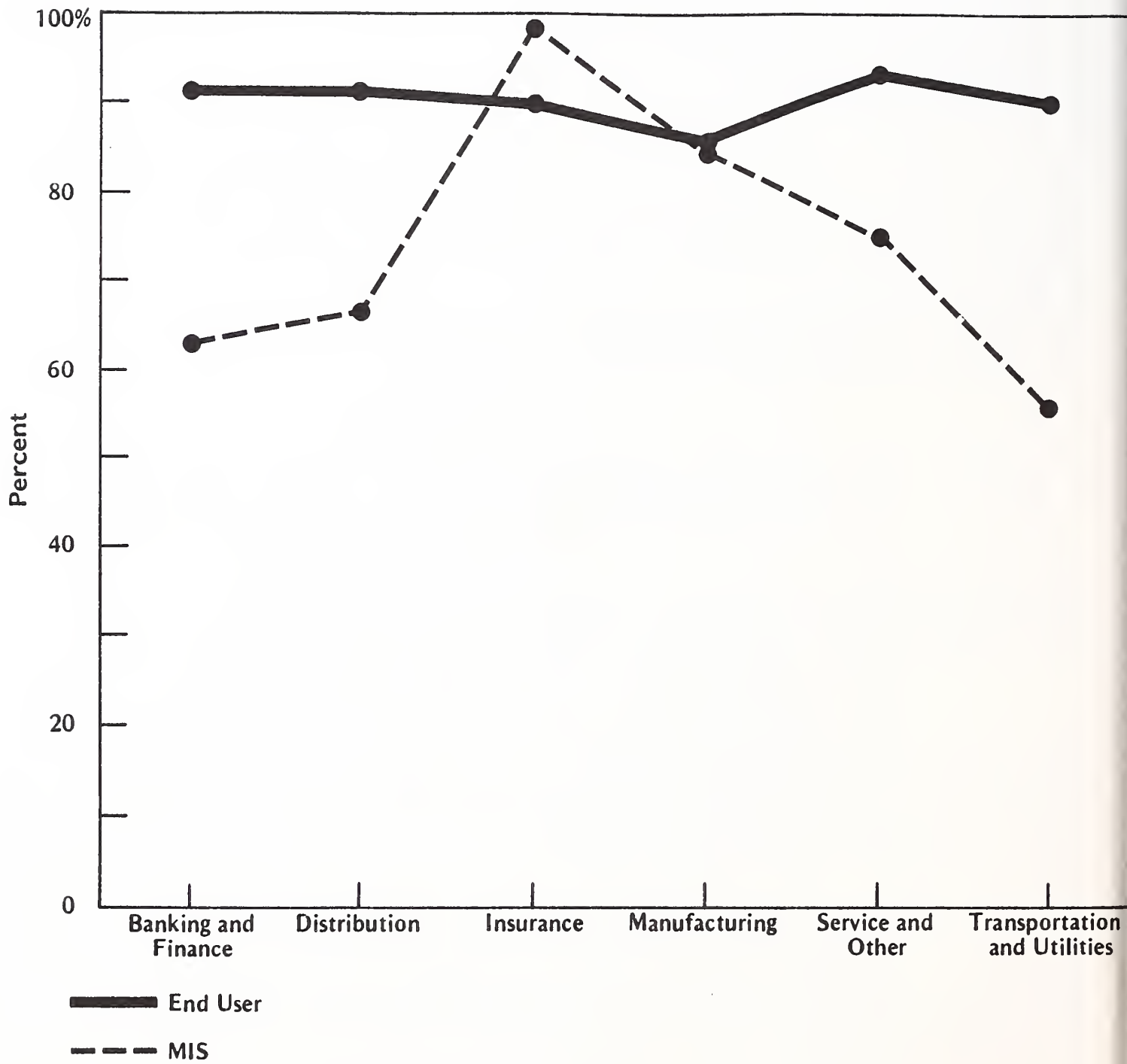


EXHIBIT III-3

INTERVIEW RESPONDENTS BY INDUSTRY  
- TACTICAL DECISIONS

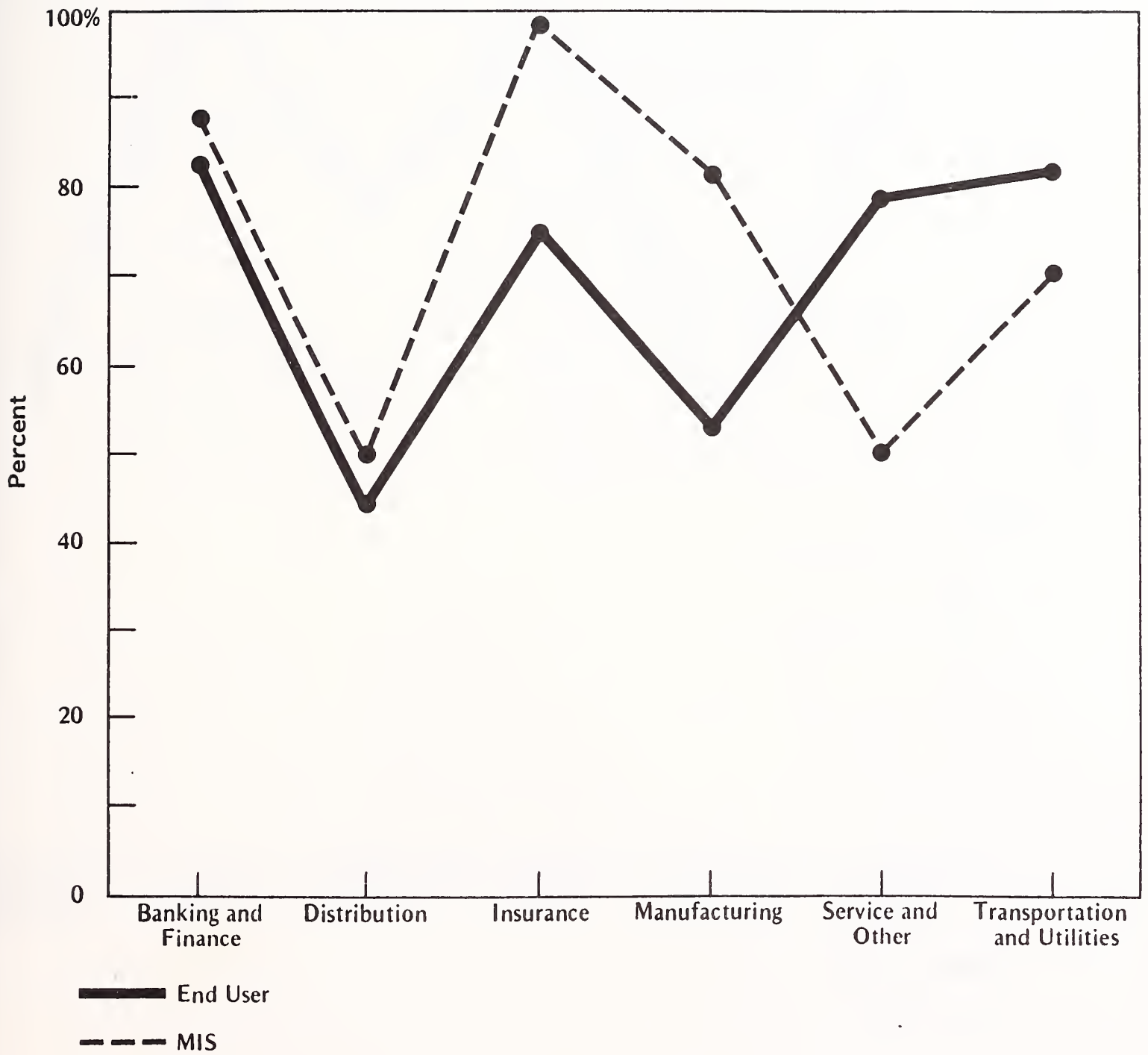
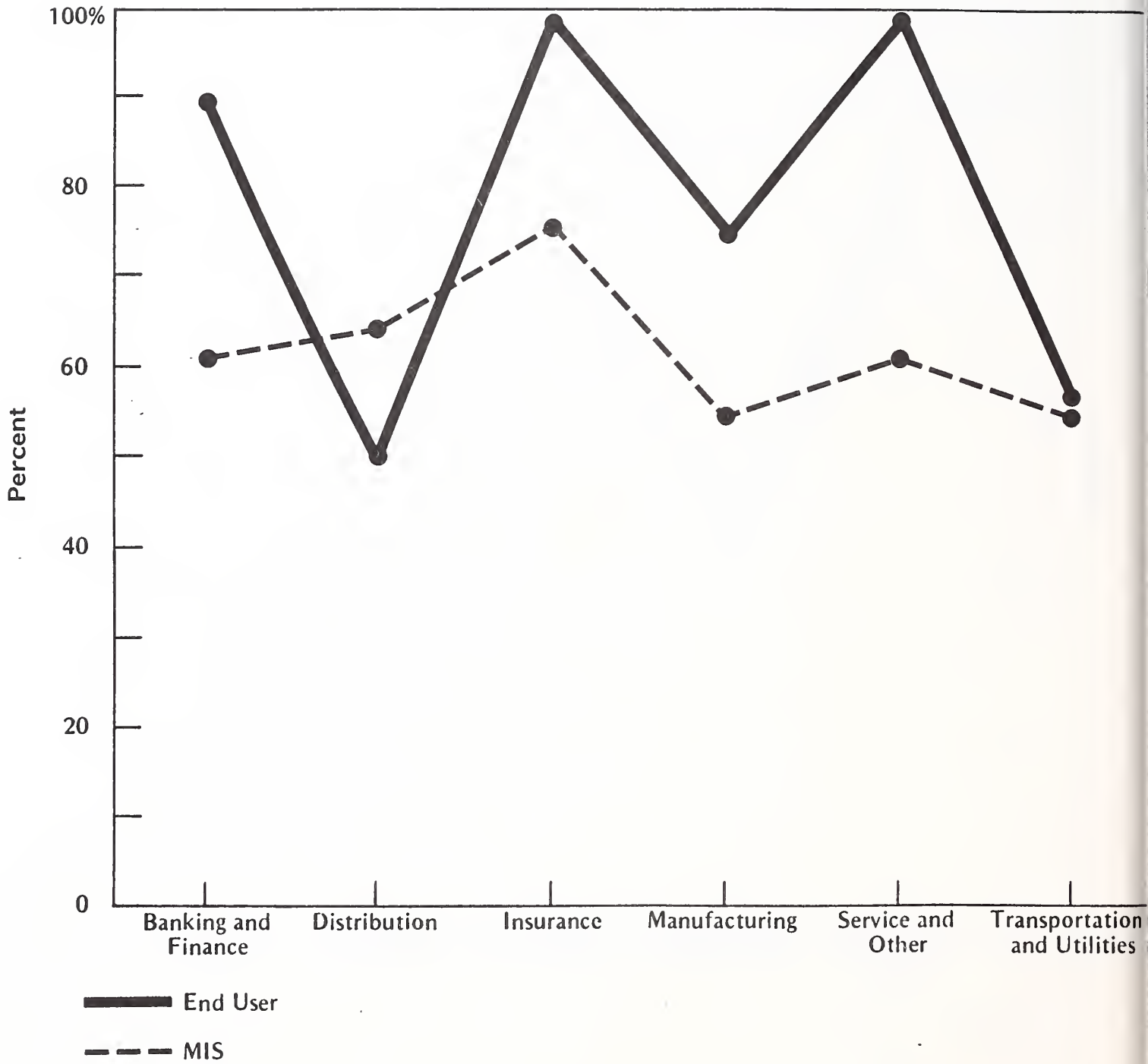


EXHIBIT III-4

INTERVIEW RESPONDENTS BY INDUSTRY  
- OPERATIONAL DECISIONS



# EXHIBIT III-5

## HOW DECISIONS ARE MADE

DECISION TYPE	DECISION-MAKING METHOD (Percent of Respondents)		
	ALONE	CONSENSUS	BRAIN- STORMING
Operation	28%	69%	49%
Tactical	28	71	47
Strategic	26	73	45

- Only slightly more than one quarter of the strategic decisions are made alone. These decisions are most likely to be highly intuitive and are therefore less likely to be supported by current DSS technology.
- Consensus and "brainstorming" are positive signals that most managers are looking for support in their decision-making roles.
- Given this broad background, what are the specific user requirements for automated decision support?
  - One significant problem in identifying user DSS requirements is that DSS concepts are not clear to the decision maker. Overall, the current requirement would apparently be a system that allows users to make evaluations and to manipulate and analyze data by themselves.
  - The problem of identifying requirements is further compounded by the vendors of decision support products. Almost every product currently advertised refers to decision support, adding to the discrepancies in definition and capability that already exist.
- Determining user DSS requirements through the interviewing process provides a list of needs that are applicable to a wide variety of systems in addition to those used for decision support, as shown in Exhibit III-6. In determining these needs it also becomes apparent that many of the responses depict DSS in terms of its connection with personal computers even though many DSS applications require the processing power of a mainframe computer.
- The first requirement is that the end-user decision maker is the primary user of the system.
  - Over 58% of the end-user decision makers surveyed use or would make use of a decision support system.



## EXHIBIT III-6

### DERIVED USER DSS REQUIREMENTS

- Decision Maker Is Actual End User for PC-Based DSS.
- The Data in Initial Applications Is Basically Financial in Nature.
- Data Is Readily Available from a Wide Variety of Sources.
- Functional System and Organizational Boundaries Can Be Transcended.
- Data and Information Is Available from External Sources.
- System Is "Easy to Use".

- This percentage is significantly higher within certain industry segments. In the insurance industry 90% of end-user decision makers indicate that they would make use of a DSS.
- Only 10% of end users identify the actual user of a DSS system as someone from the IS area.
- To an overwhelming extent, user decision makers feel that senior user management or their professional staff would be DSS users. Clerical-level subordinates are deemed to be less likely DSS users, even though in a great many instances clerical personnel will execute the system.
- Correspondingly, IS personnel indicate, to a large extent (approximately 64%), that DSS users would be within the various functional areas outside of the IS area. However, 31% of the IS personnel indicate that they would use a decision support system for their own problem-solving.
- The majority of users describe the primary information that they use in the decision-making process as being financial in nature and mainly historical. However, as a company matures in its use of decision support systems, the nature of the data used in DSS applications will change as will the DSS tools themselves. Other significant information utilized in decision support systems includes:
  - Market research (particularly in manufacturing).
  - Statistical data.
  - Money market data.
  - Economic performance indicators.

- The source of information used in decision making is, quite naturally, most often attributed to internal reports. Other sources include:
  - Trade publications.
  - Market research reports.
  - Information systems.
  - Personal/verbal contact.
- Senior management seldom cite staff as a direct source of information although they often receive the information from their staff. The high organizational levels of the decision makers surveyed, and the types of decisions they make thus preclude direct staff input.
- In order for a decision support system to be effective, it should have capabilities to access information from organizational components other than its departmental provider. Companies currently successfully utilizing DSS have strong organizational ties among the following departments:
  - Sales/marketing.
  - Finance.
  - Corporate planning/development.
  - Operations.
  - Information systems.
  - Accounting.

- Another requirement is that data and information is available from sources external to the user's corporation. Such data becomes increasingly important as a company's decision support operations become more mature.
- External organizations involved in the decision-making process vary by industry but generally include:
  - Vendors.
  - Federal and state governmental agencies.
  - Consultants.
  - Banks and other finance companies.
  - Computer companies.
- In the banking and finance and manufacturing industry sectors, competitors' actions are frequently included in the decision-making process. Many companies have established internal data bases that contain information on their competitors' products, prices, delivery times, etc.
- Only in the manufacturing segment were customers frequently credited with involvement in the decision-making process. However, many industries, particularly in the financial community, are beginning to develop "customer profitability" DSS. Using DSS will enable companies to make better tactical and strategic decisions regarding their products, individual customers, buying trends, etc. However, a problem with developing such applications is that they may often require data from a number of diverse, specific, application systems that may not have a common data base or even reside on the same equipment or location.

- The requirement most often mentioned with regard to DSS was that it should be easy to use. This, of course, refers mostly to personal computer-based decision support systems and is a term widely used by many vendors in describing their products.
- Exhibit III-7 shows the top 10 activities and functions that users indicate are important parts of a DSS.
  - The top functions currently considered necessary for an adequate decision support system are data base facilities and ease of data acquisition.
  - Similar requirements are defined by both IS and end-user personnel, although IS personnel tend to rate the more technical system aspects such as graphics and telecommunications as more important requirements.
  - There are pronounced differences between IS and end-user priorities, however, in the service and insurance industry sectors. IS groups in both sectors rate data acquisition as a much less significant requirement than do their respective end users. This is because these industries have captured significant amounts of historic data, making the mechanics of how it is obtained much less important.
  - There are some differences by industry classification that are reflected in Exhibit III-8. The most notable of these are again in the service sector, where business characteristics dictate different needs.
- Data acquisition and data base management are becoming increasingly important as more end users become familiar with computers (PCs, micros, and terminals). Once past the initial novelty, such users realize that the source and storage of accurate data is most important.

## EXHIBIT III-7

### TOP TEN DSS FUNCTIONS AND ACTIVITIES

1. Data Acquisition
2. Data Base Management
3. Forecasting Capability
4. Modeling Language
5. Spreadsheet
6. Report Generation
7. Graphics
8. Financial Functions
9. Statistical Functions
10. Telecommunications



# EXHIBIT III-8

## DSS ACTIVITIES AND FUNCTIONS RANKED\* BY IMPORTANCE

OVERALL RANKING	BY INDUSTRY							BY FUNCTION
	BANKING AND FINANCE	DISTRIBUTION	INSURANCE	MANUFACTURING	SERVICE AND OTHER	TRANSPORTATION AND UTILITIES	END-USER	DP/MIS
Data Acquisition	1	3	1	1	5	1	1	2
Data Base Management	2	1	5	2	3	2	2	1
Forecasting Capability	4	4	2	3	1	3	3	3
Modeling Language	3	5	4	4	2	5	5	4
Spreadsheet	5	2	7	5	4	6	4	5
Report Generation	6	7	9	7	6	7	6	8
Graphics	8	9	3	6	8	8	8	6
Financial Functions	7	8	10	8	NA	4	7	7
Statistical Functions	10	6	NA	9	9	9	9	10
Telecommunications	9	10	NA	NA	7	10	10	9

\*Ranking: 1 = High Importance, 10 = Low Importance.

- Often this data may not reconcile with other data in the company, forcing the DSS user to determine, if possible, the best source and most accurate data.
  - Many companies have tried to develop large, centralized corporate data bases only to face user requests for more decentralized data. This presents problems in terms of accessibility, timeliness and control.
  - There is a growing demand by end users to have immediate access to the latest "live data." This is particularly true for users of decision support systems who are increasingly challenging IS managers to modify their operational modes significantly.
  - However, once a specific analysis is complete, there are usually few, if any, attempts made by DSS users to confirm the validity of the results. Decentralization of data and decision making can therefore create "two sets of books" for a company.
- Forecasting capability is important in order to reduce the time spent gathering and manipulating historical and budget/forecast data.
    - An example of the forecasting "time crunch" is the need for many businesses, particularly in the midsize manufacturing category, to undertake significant data processing efforts to produce "flash" reports. Such reports are often generated on a biweekly basis and it may take IS a week or more to complete the required system processing.
    - Many companies also revise their planning budgets two or three times a year. Many financial application packages provide the capability to handle multiple plans. Coupled with the appropriate forecasting capability, they can reduce the mechanical and managerial time devoted to this planning process.

- This in turn will allow senior and executive managers to devote more time to making strategically important decisions.
- Spreadsheets, which are synonymous with DSS to many users, are only the fifth most important aspect of a DSS according to the users surveyed (see Exhibit III-8).
  - This is because spreadsheets support very rigid types of decision making with well-established sets of:
    - Goals.
    - Assumptions.
    - Cause-effect relationships.
    - Data variables.
  - Since these qualities are more often associated with operational and tactical decisions than with strategic decisions, the spreadsheet, which is currently prevalent as a DSS tool, and largely responsible for the popularity of DSS, will diminish in its identification as a total decision support system and its use as a standalone application.
- Data base management systems allow for more ad hoc analysis in ambiguous situations and there are few, if any, cause-and-effect relationships. Most current data base systems are rigidly designed to support the nature of the ad hoc requests of senior executives, who are continually confronted with:
  - Unstructured problems.
  - Competitive maneuvering.

- Uncertain economics.
- Rapidly changing circumstances.
- Because of these issues, numerous "noncomputer" companies have attempted to develop their own data base management systems with varying degrees of success. Companies that have succeeded developed such systems around very specific functions and applications.
- Many other factors emerged as user requirements during this study, including:
  - A strong desire on the part of end users to eliminate the growing backlog within IS of applications development and modification.
  - A desire to have a faster means of performing functional analysis.
  - A desire to eliminate the frustration of attempting to perform sophisticated, multidimensional analyses with reports generated by traditional transaction-processing systems.
- All of these factors are not viewed by users as changing dramatically over the next two to three years.

## C. DECISION SUPPORT SYSTEMS

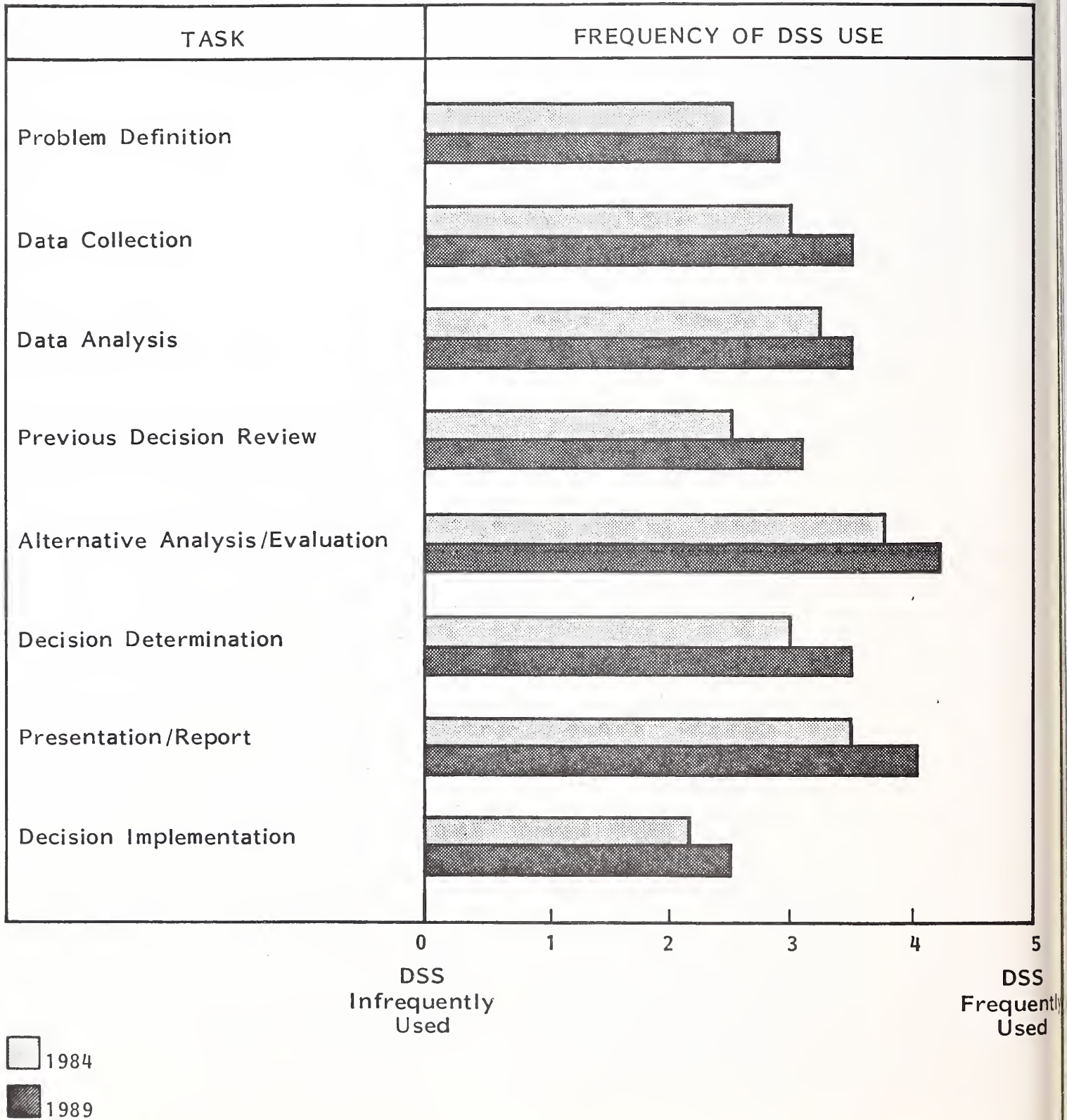
### I. CURRENT USE IN DECISION MAKING

- Having defined decision support systems and indicated the scope of their use in support of strategic, tactical and operational decision making, an examination of how decision support systems are specifically used, and what functions they support follows.

- Exhibit III-9 shows the typical tasks associated with decision making for which decision support systems are and will be used. No change is anticipated over the next two to three years in the overall weighted average ranking of the use of a DSS in support of these various decision-making tasks. However, the overall use of DSS in support of decision making can be expected to increase, as reflected by the higher across-the-board future averages.
- Data analysis, alternative evaluation ("what-ifs"), and reporting are the three tasks for which a DSS is most frequently used.
- Decision support systems are infrequently used for defining problems and implementing decisions. The indications are that this trend will continue since current DSS tools are generally inadequate for supporting such tasks.
  - At executive levels in organizations, a greater need exists for support in the area of problem definition and alternative analysis than in "number crunching." Unfortunately, number crunching is the mainstay forte of much software that is currently identified with decision support systems.
  - Decision support software currently has little capability for supporting the "action phase" (implementation) of decision making. However, knowledge-based/expert systems do track previous actions in decision implementation and use them to make increasingly accurate forecasts/analyses.
- Interestingly, although data acquisition is considered the most important function of a DSS (see Exhibit III-7), it is only viewed as of average importance as a decision making task supported by a DSS. Accurate data gathering is difficult and time consuming, but the process itself is not of importance to decision making except to ensure use of appropriate and correct data.



## DECISION-MAKING TASKS SUPPORTED BY A DSS





- For senior management, the tasks of decision communication and implementation are as important as decision determination.
- Exhibit III-10 shows the primary DSS applications by industry sector. The most heavily used application in all industries except manufacturing is financial analysis.
  - Even in manufacturing, DSS is used mainly as a financial application (budgeting/profit planning), although it is more short term in nature.
  - Furthermore, while we have included budgeting and profit planning as a DSS application, the function is often provided as a part of many standard financial application packages, most notably with general ledger systems.
- Important applications of decision support systems within the insurance, manufacturing and transportation industries include price analysis and market research. This is a natural application of DSS in industries that are more competitive and, therefore, more price-sensitive.

## 2. DSS PRODUCTS, SERVICES, AND DELIVERY MECHANISMS

- Current offerings from vendors in conjunction with decision support systems cover the full range of information services products including hardware, software and services.
  - In the hardware category, there are special-purpose machines available that interpret symbols instead of alphanumeric instructions through a language called LISP (meaning list processor) or another similar language PROLOG (meaning programming in logic.) These machines, usually referred to as LISP machines, will be discussed in more detail in the following section.

## DSS APPLICATIONS RANKED\* BY USE IN INDUSTRY

	BANKING AND FINANCE	DISTRIBUTION	INSURANCE	MANUFACTURING	SERVICES AND OTHERS	TRANSPORTATION AND UTILITIES
Financial Analysis	1	1	1	3	1	1
Planning	3	2	-	5	3	2
Pricing/Market Research	-	-	3	2	-	4
Forecasting	2	3	6	4	-	3
Budgeting/Profit Planning	7	-	5	1	5	6
Modeling/Operations Analysis/Control	5	5	-	10	2	-
Customer Analysis	4	-	-	-	-	7
Resource Allocation	-	4	-	7	-	-
Data Management	6	-	-	-	6	5
Acquisition Analysis	-	-	-	8	4	-
Product Line/Sales Analysis	-	7	-	6	-	-
Investment/Portfolio Analysis	8	8	2	9	-	-
Reporting/Word Processing/ Electronic Mail, Graphics	9	6	4	-	-	8

\*Ranking: 1 = High Importance, 10 = Low Importance

- Hardware in relation to DSS is also important in that a significant portion of personal computer sales can be attributed to DSS software products such as spreadsheets.
- The amount of decision support software available is very large and covers nearly every type/level category of hardware currently on the market. The current strong focus on decision support systems largely stems from this prevalent supply of software and vendor pronouncements of its availability. Software now identified with decision support includes:
  - Financial modeling systems including the classic spreadsheets.
  - Data base management systems (DBMS) usually in conjunction with an associated, integrated inquiry facility.
  - Fourth generation languages--facilities that allow end users to access and manipulate data more easily.
  - Natural language query systems--facilities that allow English-like commands/requests to be executed.
  - Expert systems and expert-systems generators--advanced forms of decision support systems that some industry analysts predict are the ultimate end product of functional developments with DSS.
- DSS-related services provide:
  - Personnel with DSS backgrounds and experience.
  - External data bases (econometric and/or demographic data, for example).
  - Large-scale remote computing services and systems.

- The predominant processing vehicles for DSS are on personal computers and on mainframes.
  - Personal computer use in companies is expected to increase by more than 250% by 1986.
  - Personal computer use for decision support is currently highest in the distribution and the transportation and utilities industry sectors where noncentralized systems have traditionally been most frequently developed.
  - In the banking and finance and the insurance industry sectors, use of personal computers and mainframes for DSS are approximately equal, a significant finding considering that these types of industries have been traditionally heavily mainframe-oriented.
  - A large percent of users indicated that they would decrease their dependency on remote computing services over the forecast period.
  - The predominant vehicles for current DSS are indicated in Exhibit III-11. End-user and IS responses are consistent within companies where multiple interviews were conducted.
- Many people, organizations and functions contribute to developing data-processing systems. Exhibits III-12 through III-15 depict the importance of the various parties in defining, building, using and maintaining decision support systems.
  - These exhibits reflect the perceived levels of contribution as viewed by the IS personnel as well as the end users, both currently and in two to three years.

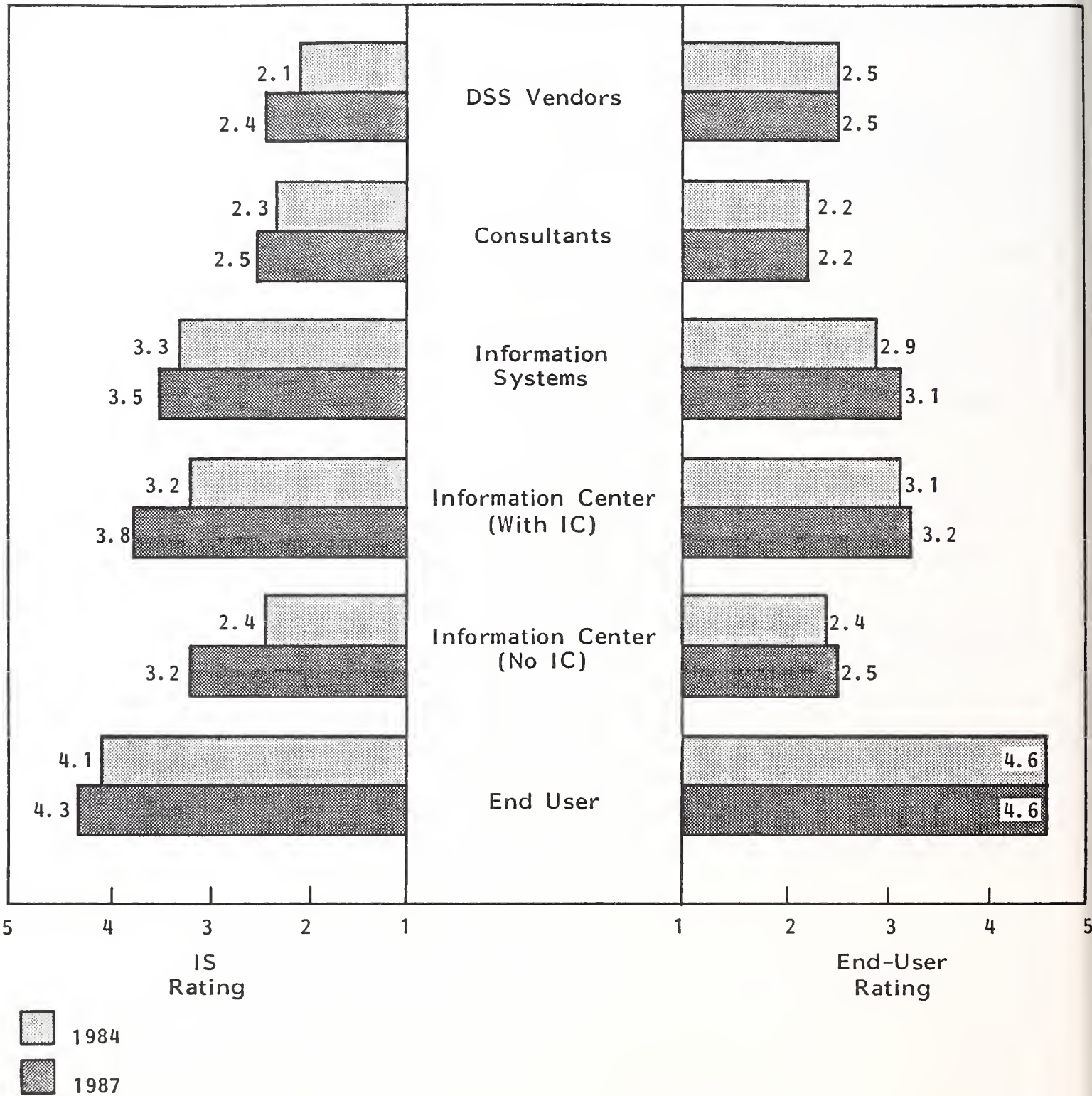
## DSS DELIVERY VEHICLES BY INDUSTRY

DELIVERY MODE	PERCENT OF RESPONDENTS				
	MAINFRAME	MINI- COMPUTER	PERSONAL COMPUTER	REMOTE COMPUTING SERVICE	TURNKEY SYSTEMS
Banking & Finance	68%	36%	68%	40%	16%
Distribution	60	7	87	13	7
Insurance	75	38	75	63	63
Manufacturing	80	33	76	40	12
Service & Other	88	31	69	36	-
Transportation & Utilities	67	44	38	33	6
Overall Average	75%	32%	76%	36%	12%



# EXHIBIT III-12

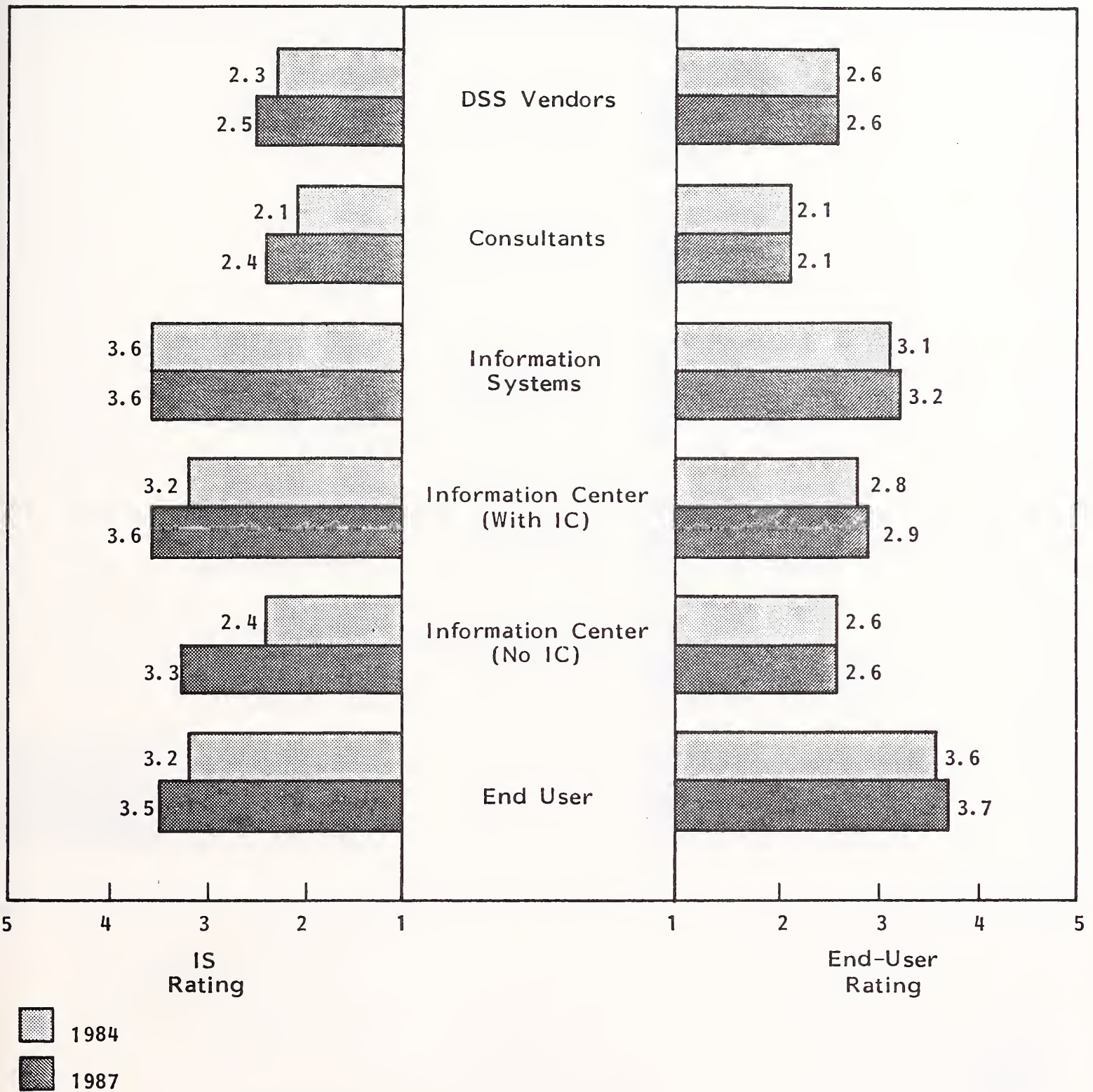
## ROLES IN DEFINING DECISION SUPPORT SYSTEMS





# EXHIBIT III-13

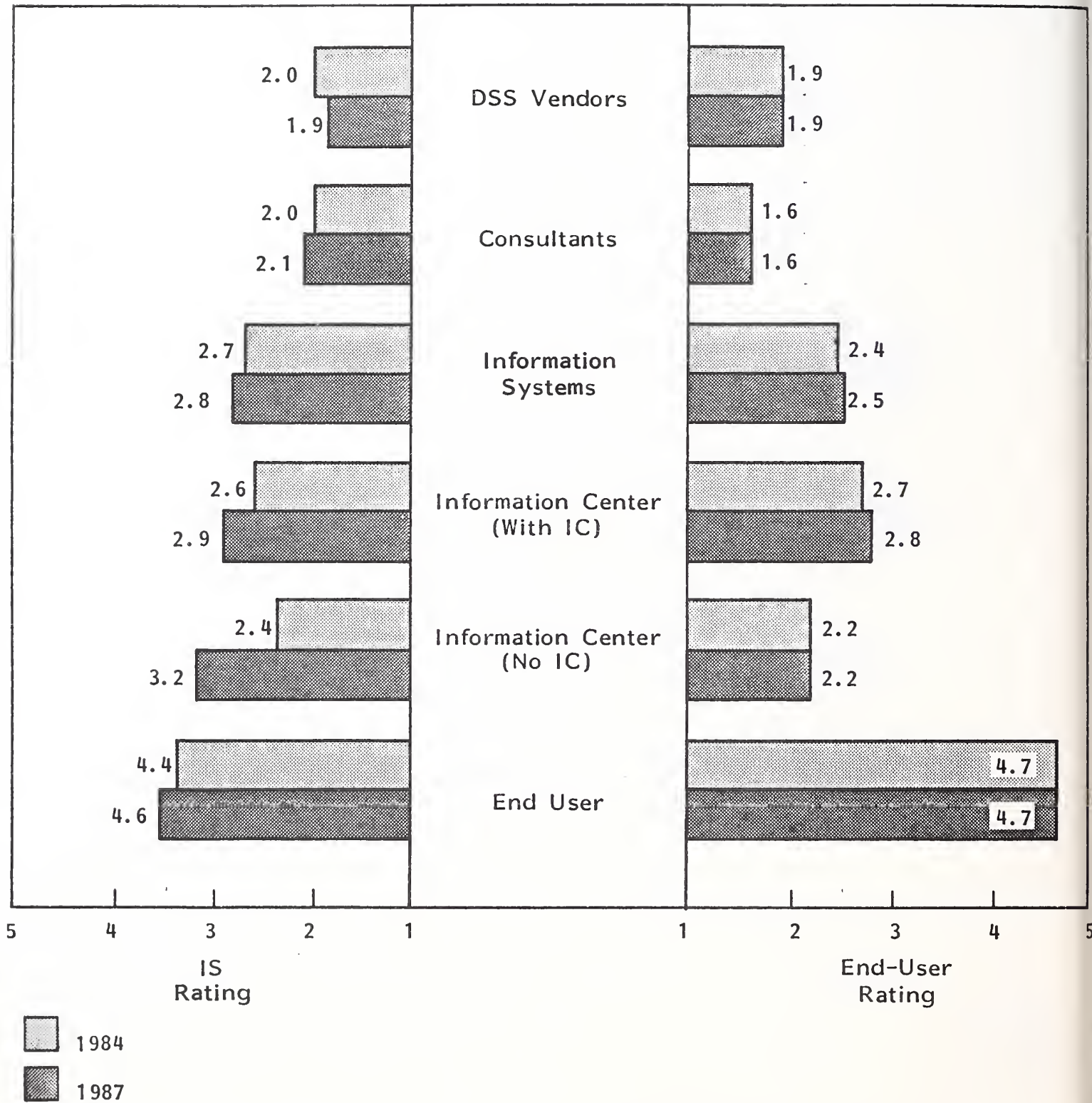
## ROLES IN BUILDING DECISION SUPPORT SYSTEMS



Rating: 1 = Low Importance, 5 = High Importance.

# EXHIBIT III-14

## ROLES IN USING DECISION SUPPORT SYSTEMS

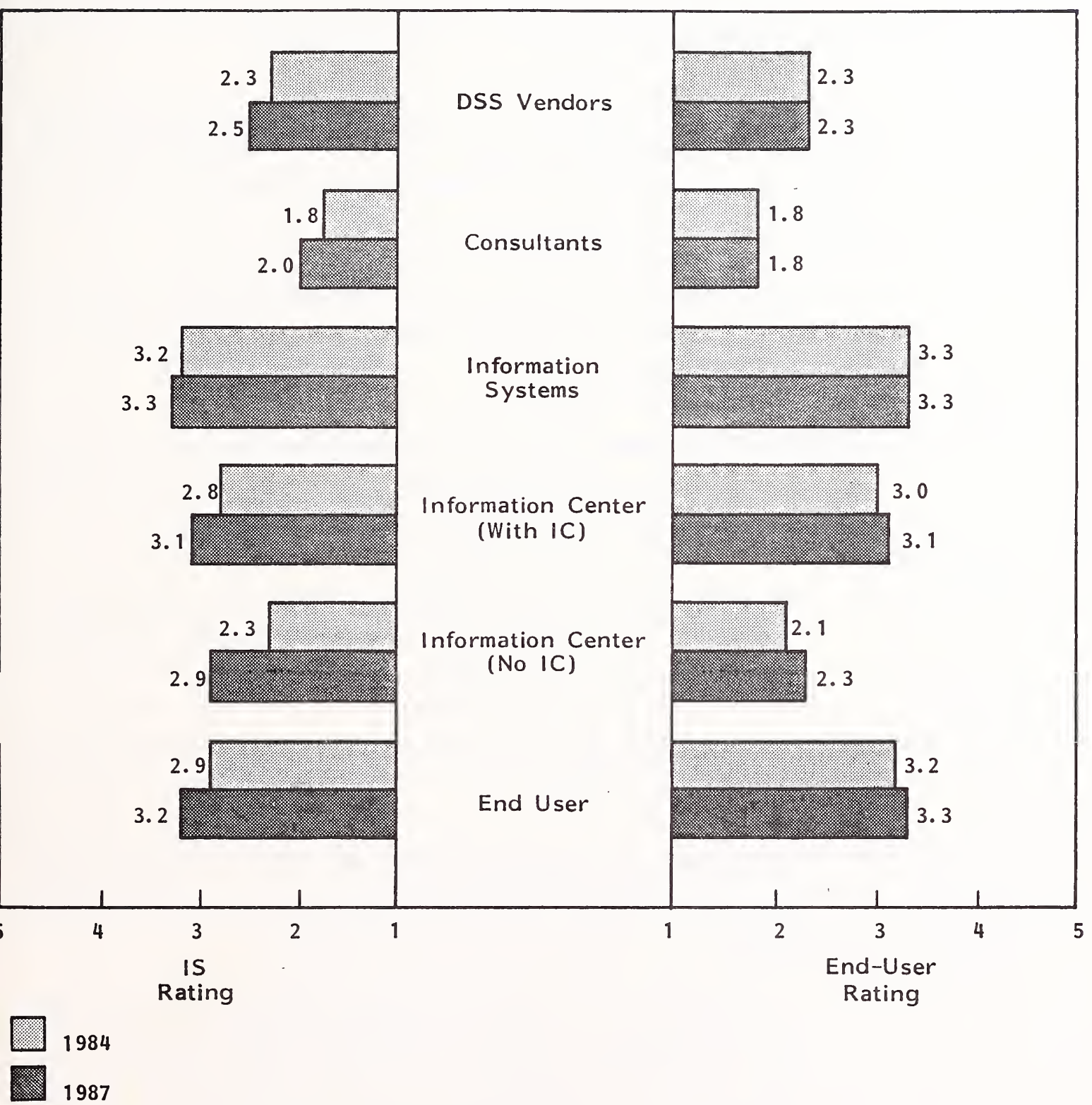


Rating: 1 = Low Importance, 5 = High Importance.



EXHIBIT III-15

ROLES IN MAINTAINING DECISION SUPPORT SYSTEMS



Rating: 1 = Low Importance, 5 = High Importance.

- Each exhibit shows one of the four primary phases in the life of a DSS (definition, development, use and maintenance) and the role each party plays in that phase. For contrast, the role of the information center (IC) is depicted for both those companies with an existing IC and those without.
- In general, DSS end users currently have the highest perceived levels of contribution for defining DSS applications, as shown in Exhibit III-12. This will remain true in the next two to three years. Both end users and IS personnel in all industry sectors have similar views.
  - The information center is also seen as playing an important role in the definition of DSS applications, particularly in those companies that currently have an IC.
- End users, IS departments and information centers show almost the same prominence as builders of DSS applications, as shown in Exhibit III-13. These levels of contribution will continue for the next two to three years.
  - IS and end users contribute equally to building DSS applications on mainframes, while end users are the primary builders of personal computer decision support systems.
- Utilization of decision support systems is quite obviously the realm of the end user, as shown in Exhibit III-14.
  - IS personnel from companies without an existing information center increasingly see the IC as being a significant user of decision support systems.
  - IS managers see the information center as being a more important factor concerning all facets of DSS than do their corresponding end users. This can be attributed to the fact that the concept of information centers is not fully understood, particularly by end users.

- DSS users continue to rely heavily on the IS department for maintaining their DSS applications, as shown in Exhibit III-15.
  - While this trend will continue, the information center will start to replace IS as the primary source of DSS application maintenance.
  - End users see themselves emerging as a maintainer of DSS, which is a logical adjunct to being a definer, builder and user of such products.
- Certain industry sectors do not follow these overall patterns. Such is the case in the distribution industry sector, where the end user is primarily viewed as responsible for DSS maintenance from both end-user and IS perspectives.
  - In the insurance sector, IS personnel see the end user, vendor, and the information center as having a greater maintenance responsibility than themselves.
  - The DSS as an end-user system, therefore, is apparently moving away from the realm of data processing, according to user interview respondents.
- Other than providing DSS products and services, vendors are seen as having a low level of involvement in defining, building, using and maintaining DSS applications.
  - End users within the various industry categories generally place more importance on use of vendors in defining and building DSS than their IS counterparts, who perceive a larger role for themselves. By contrast IS managers in the insurance industry sector look to use of vendors for these functions.

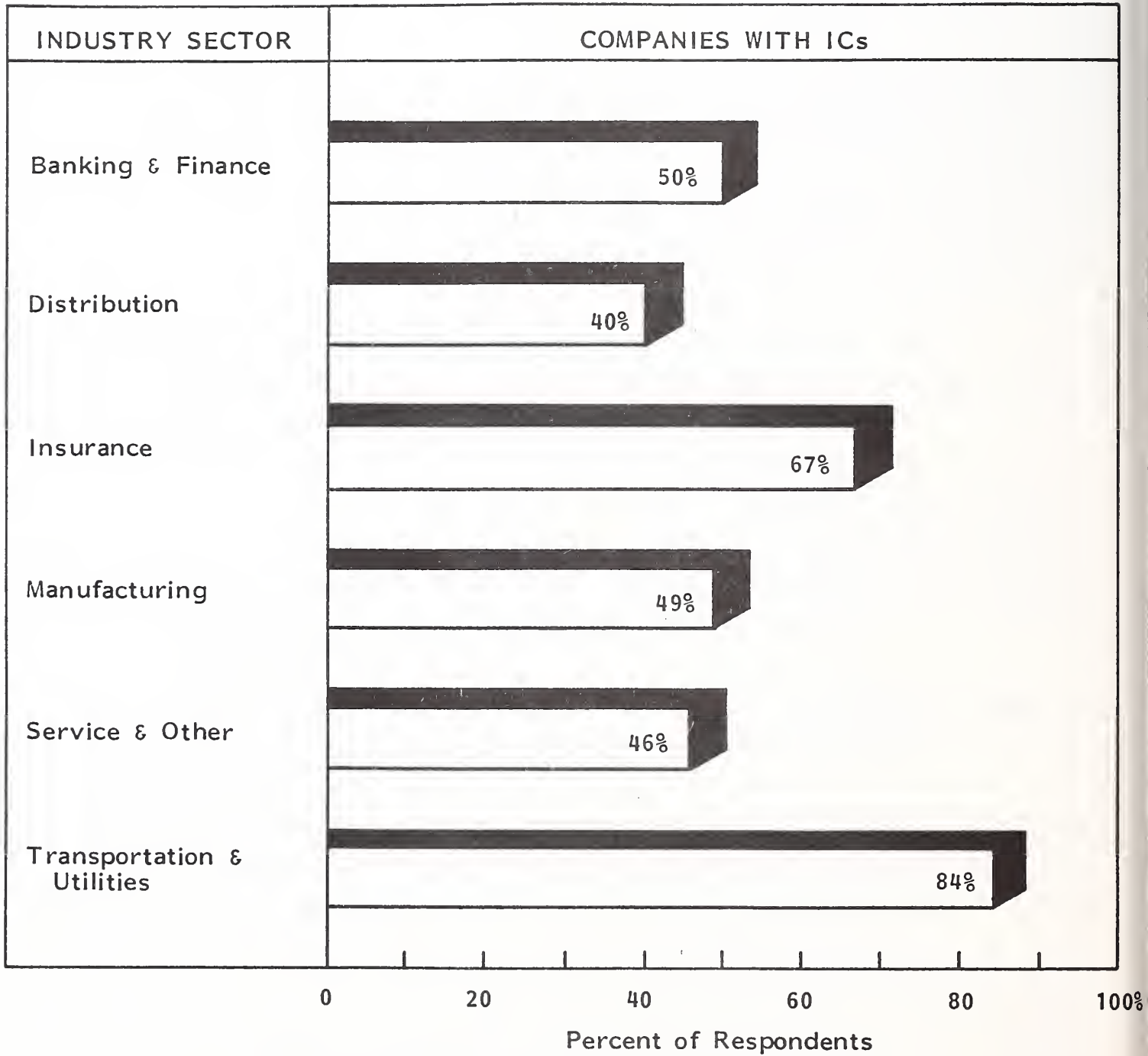


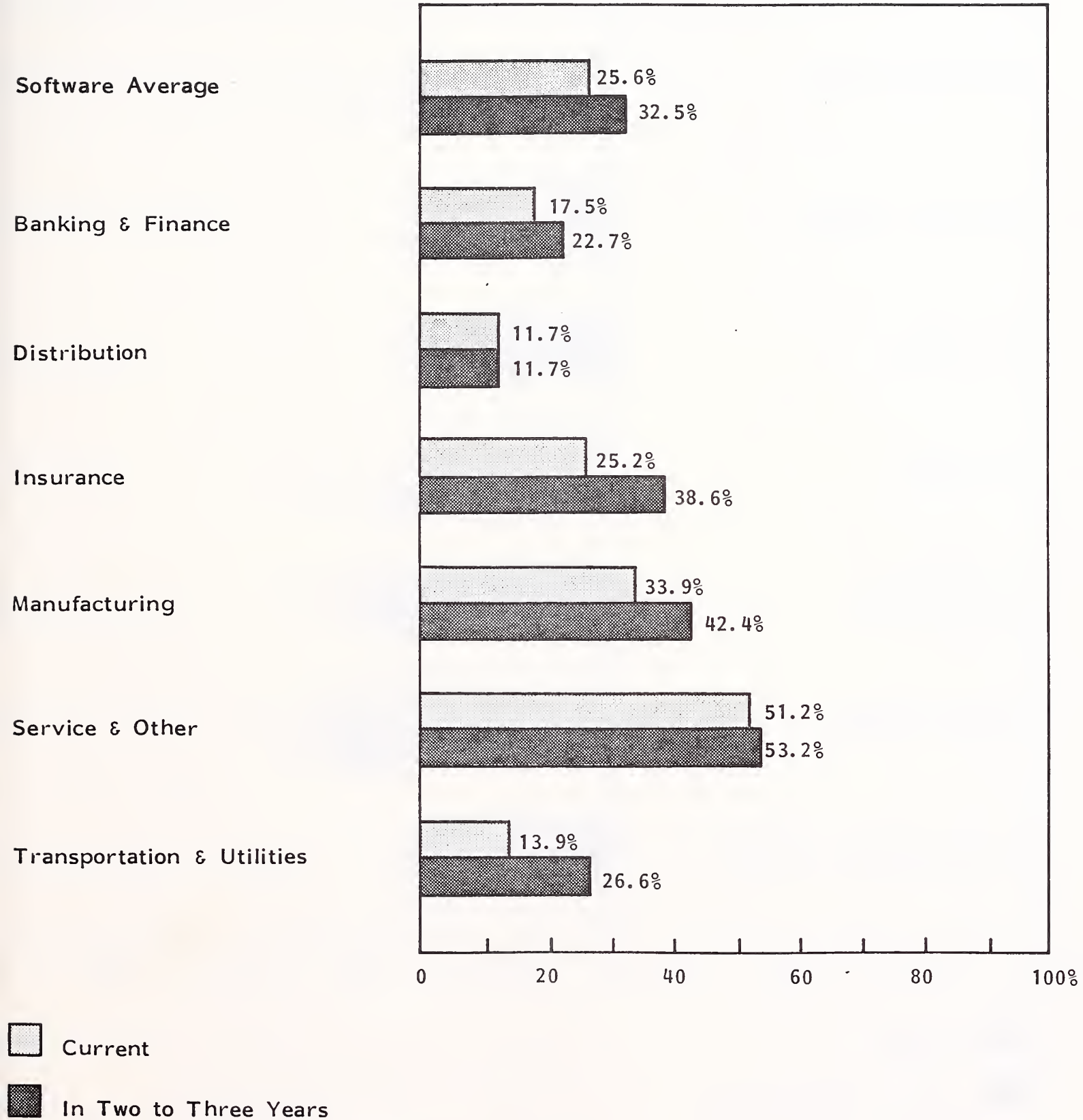
- As DSS applications become increasingly complex, however, both end users and IS personnel will begin to seek out whatever assistance they can obtain for implementation of decision support systems.
- Consultants are not widely seen as having a role in building, utilizing or maintaining decision support systems by users.
  - Generally speaking, end users foresee little change in the use of consultants while their IS counterparts see increasing use of consultants. However, consultants have been used in several of the more advanced companies with respect to DSS, fulfilling a role as a catalyst in bringing about significant changes associated with strategic, tactical or operational decision making.
  - The main use of consultants, both currently and in the future, is in the definition of decision support system requirements.
  - Consultants are being more frequently used in the services and other industry sector. This sector is generally comprised of companies that are less dependent on senior management which results in the increased use of external consulting expertise.
- The primary roles of information systems personnel are quite naturally in building and maintaining decision support systems.
  - In the banking and finance, service, and other industry sectors, IS personnel expressed a desire to play a larger role in defining DSS requirements.
  - In the insurance industry sector, IS personnel do not view DSS maintenance as part of their primary function, either currently or in the future. This contrasts sharply with the banking and finance, service, and other industry sectors where IS personnel consider the maintenance of decision support systems as of prime importance.

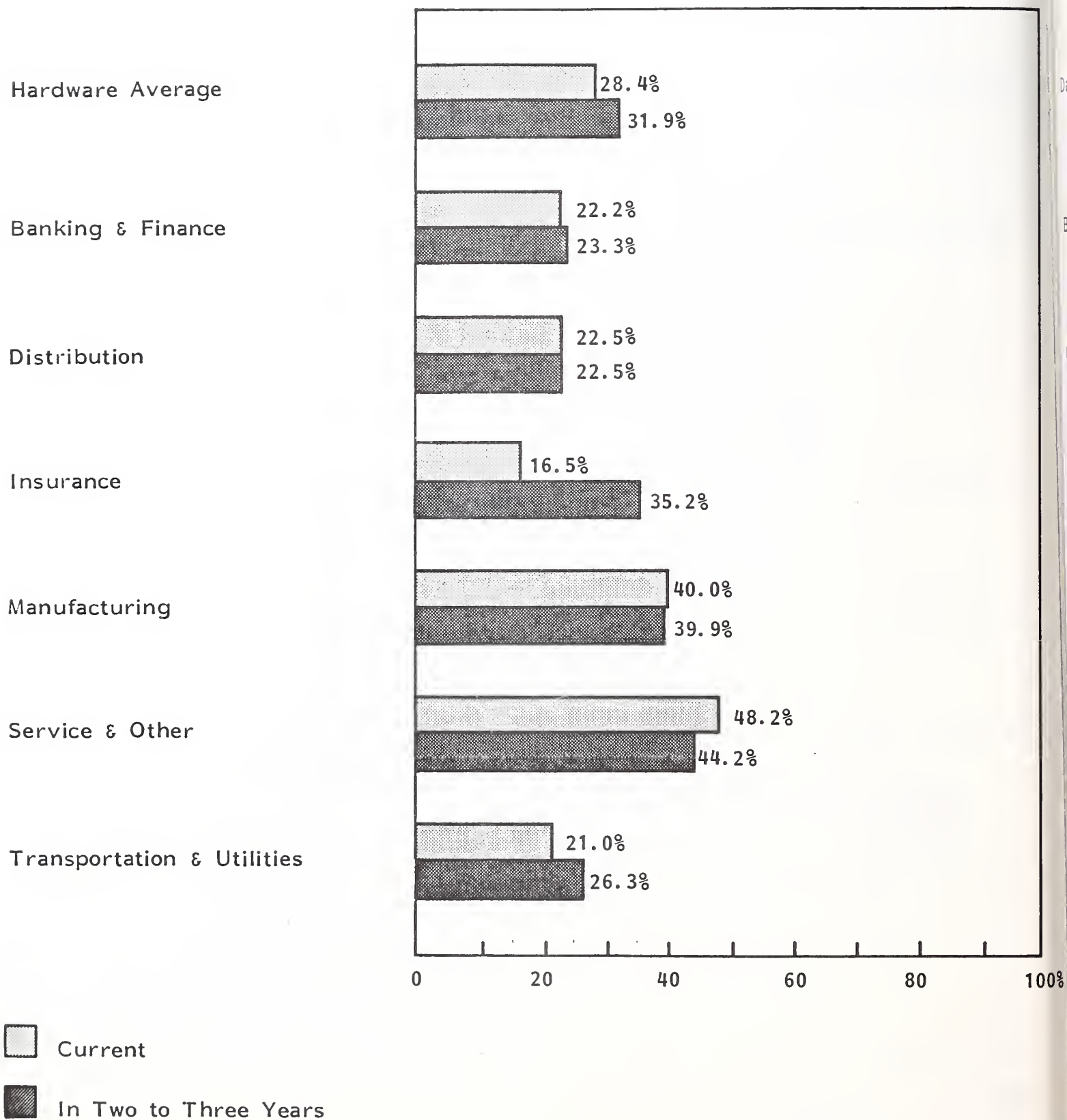


- Information Systems personnel generally view themselves as having a greater role in defining, building, using and maintaining decision support systems than do their end-user counterparts. This is the overall trend predicted by INPUT for the development of DSS applications.
- The role of the information center is viewed differently by those firms that currently have an information center as opposed to those that do not.
  - This can be attributed to the lack of a full understanding of the concept of an information center.
  - Insurance industry firms that currently operate information centers view the IC as playing a less significant role in the next two to three years. This is possibly due to the failure to establish an IC in certain environments--such as those in which a currently large, centralized IS function exists.
  - There also appears to be a problem establishing an IC in companies that have a "personal computer store."
- The percent of survey respondents utilizing an information center is approximately 53%. Classification by industry is shown in Exhibit III-16.
- Exhibits III-17, III-18, III-19, III-20, and III-21 reflect the various decision support needs fulfilled by the information center. Each chart reflects one or two needs, current fulfillment of those needs from an overall as well as from an industry-specific perspective, and predictions regarding the fulfillment of various needs in two to three years.
  - From an overall perspective, the banking and finance and the transportation and utilities industries are significantly behind all other industries in all aspects of IC implementation and needs fulfillment.

## INFORMATION CENTER USE BY INDUSTRY

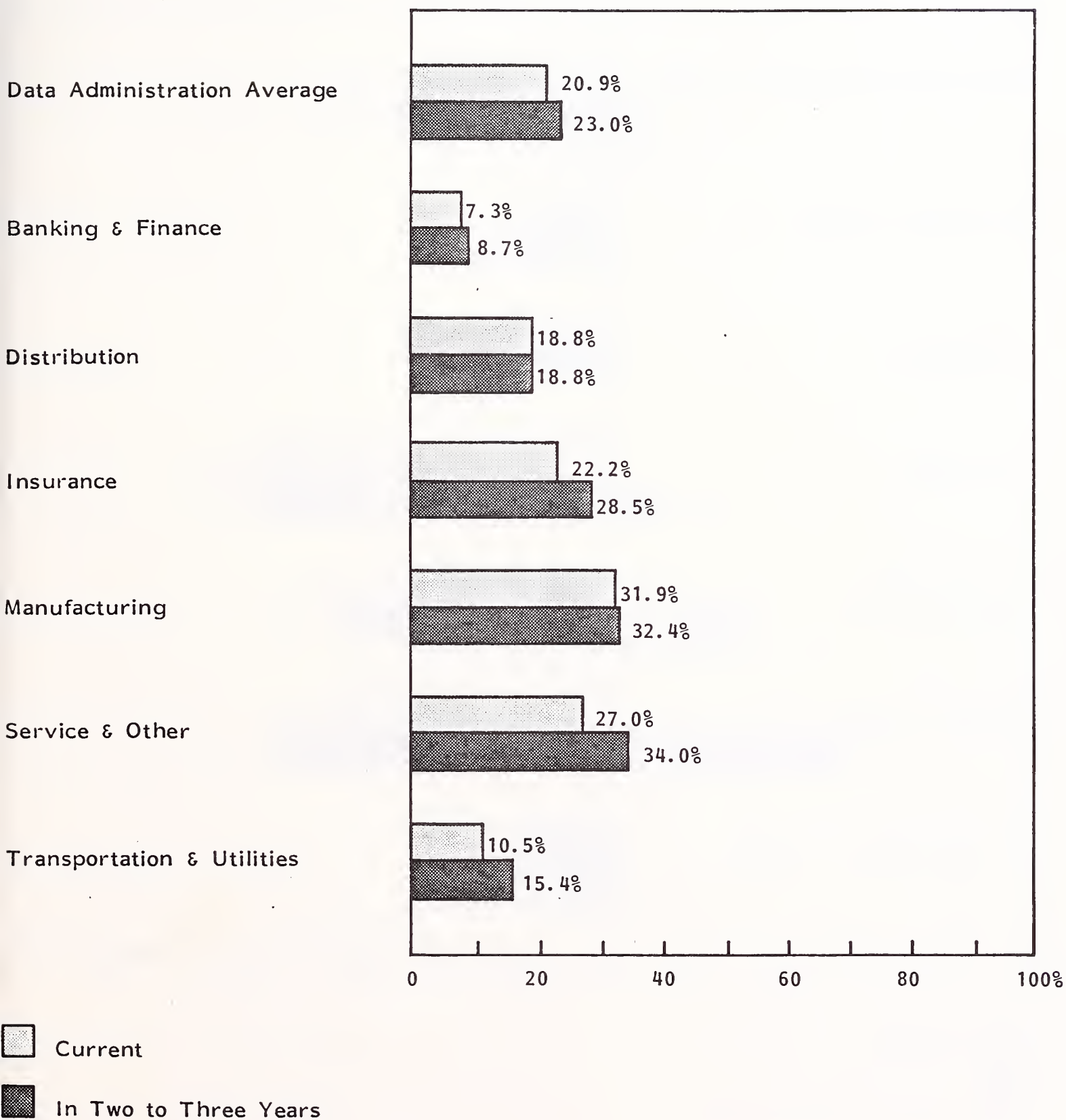


INFORMATION CENTER FULFILLMENT OF  
SOFTWARE NEEDS

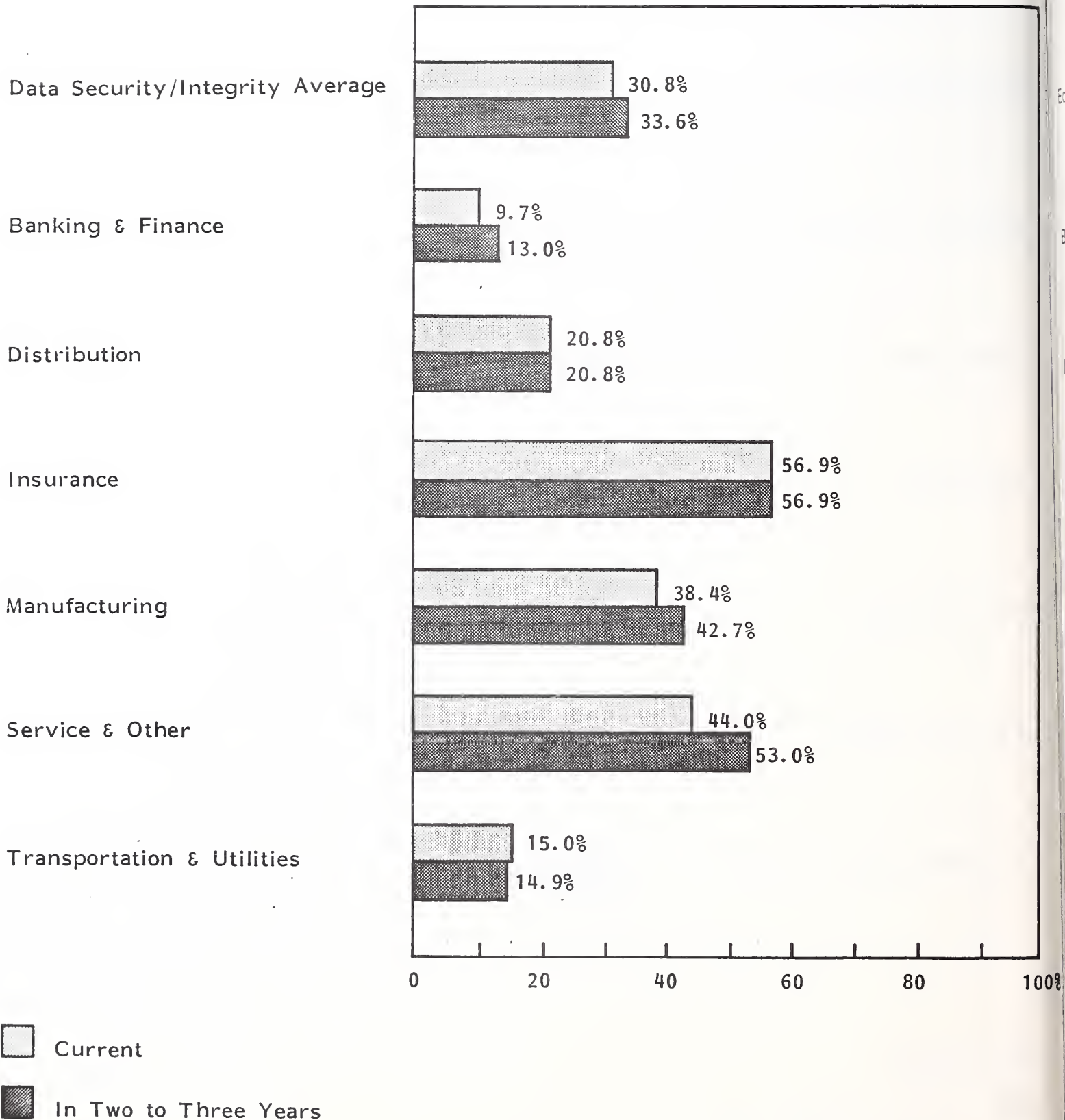
INFORMATION CENTER FULFILLMENT OF  
HARDWARE NEEDS

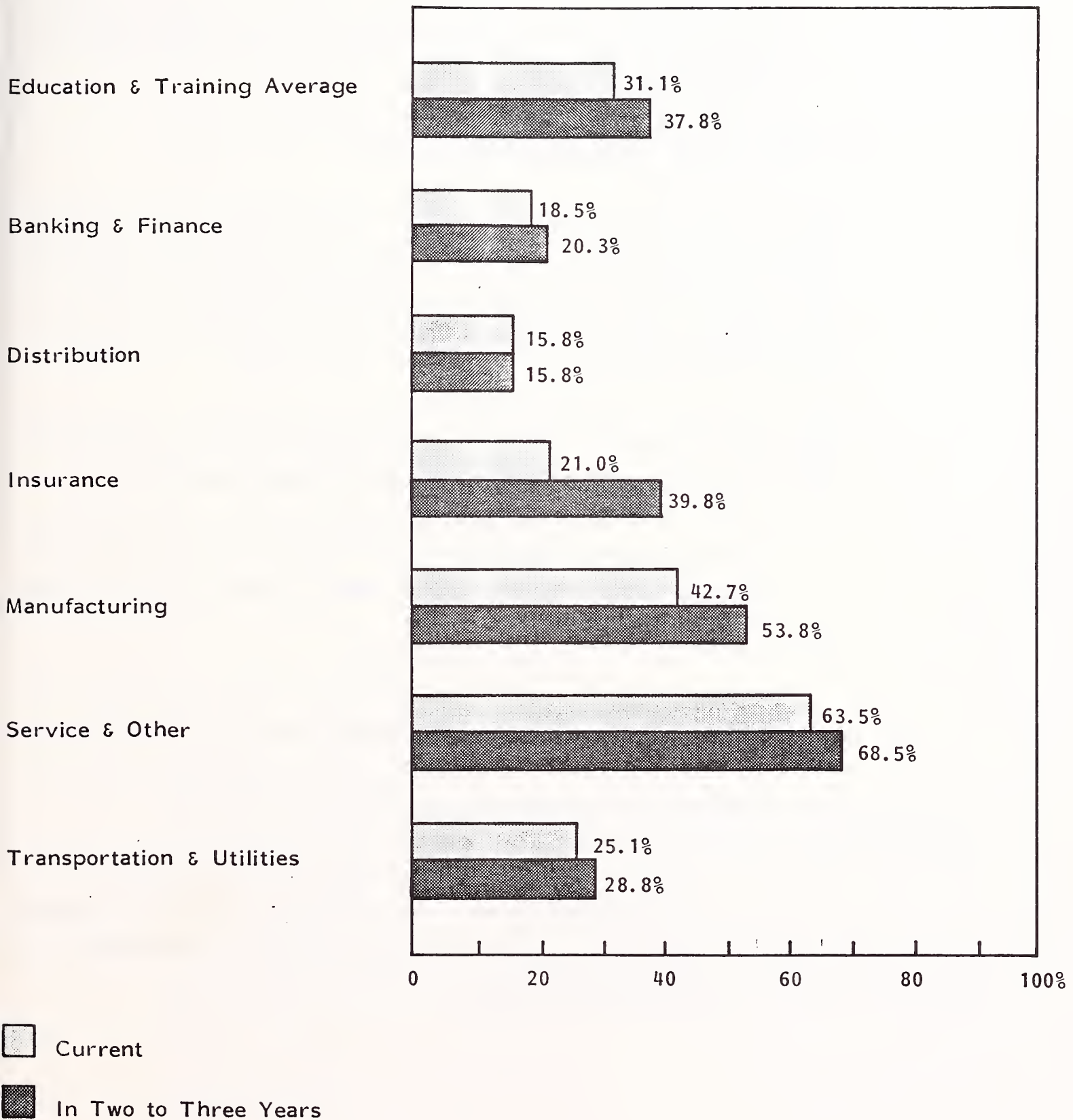


## EXHIBIT III-19

INFORMATION CENTER FULFILLMENT OF  
DATA ADMINISTRATION



INFORMATION CENTER FULFILLMENT OF  
SECURITY NEEDS

INFORMATION CENTER FULFILLMENT OF  
DSS EDUCATION AND TRAINING NEEDS

- It is also apparent that the primary role played by the IC, both currently and in the near future is in the area of education and training, while the least important role is in the area of data administration. Both of these trends reflect overall industry directions pointing to increasing needs for education and increasing user determination to maintain their own data.

### 3. FUTURE ROLE OF DSS IN DECISION MAKING

- There is little doubt that decision support systems will become increasingly important parts of corporate decision making. In a relatively few years, DSS tools and techniques have moved from the halls of academia to many corporate offices, and senior-level managers are now beginning to reap the benefits of automated decision support.
- There are, however, still significant problems to solve before computers can realistically be depended upon to make strategic management decisions.
  - Managers are now finding some inconsistencies in the data they deal with, especially in environments in which there is no central data base or information repository.
  - People are making some significant errors in the use of their DSS tools. Common early programming practices such as crossfooting or hash totaling are often neglected, or are sometimes beyond the capabilities of the decision support tool that is being used.
  - Rekeying data from manual reports is always prone to error. One critical decision made with incorrect data and a manager may lose his confidence in the computer as a decision tool, as well as losing his job.

## D. ARTIFICIAL INTELLIGENCE AND DECISION MAKING

### I. ARTIFICIAL INTELLIGENCE DEFINITIONS

- Much of the confusion surrounding the direction of decision support systems is their identification with artificial intelligence and/or expert systems. Artificial intelligence (AI) is also a term many experts are struggling to define, but the field can be thought of as comprising the following products: .
  - Robotics.
  - Artificial intelligence machines.
  - Vision systems.
  - Voice recognition/synthesis.
  - Expert and knowledge-based systems.
  - Expert-system generators.
  - Natural language query systems.
  - Definitions of these terms are included in Appendix A.
- Early AI applications have been helping solve difficult technical problems in fields such as medicine, chemistry, and oil exploration, but have not generally been of use in a normal commercial environment.
- The robotics component of AI uses computers to perform tasks normally performed by a human through use of anthropomorphic devices (arms, hands, etc.).



- Robotics has made inroads in a number of specific applications and industries, most notably in automobile manufacturing. Currently more than 80% of all robotics applications are in the auto industry with more than 40% of all functional applications in the spot-welding area.
  - Robotics will not be as widespread as early projections had indicated. While there are some cost-effective areas where robots will be useful, they do not appear to have become as popular as was envisioned a few years ago.
  - It is possible that some significant technological advances may brighten the picture, but it appears that robotics has a limited future, existing mainly in narrowly defined, highly specialized areas.
- Vision systems deal with the ability of a computer to delineate objects based on sensory-image recognition. Voice recognition/synthesis deals with the ability of a computer to understand human speech and the ability to respond through a voice mechanism.
    - Both of these segments of artificial intelligence are in their infant stages of development and will be slow to advance due to the high level of technological progress required.
    - They have an ability to understand conversational English.
    - They have an ability to respond to similar questions, worded in a variety of ways, with like answers.
    - They can resolve ambiguities in requests made.
    - They allow the user to access data without knowledge of exactly how the data is stored or ordered.



- Users can extract data from data bases using free-form inquiries that do not have to be phrased in a specific procedural language, and are more like normal conversational inquiries.
- Natural language query systems are able to distinguish whether a query such as "List all owners of red and green cars" means owners of red cars and owners of green cars or owners of cars that are red and green.
- The current user base of natural language query systems is quite small, but as these systems become cheaper, their use will increase. Some of the current speech synthesis/recognition products are reflected in Exhibit III-22.

## 2. CURRENT ROLE IN DECISION MAKING

- Branches of AI that are beginning to emerge from the research laboratories and are gradually expanding to play a role in automated decision support include:
  - Natural language query systems.
  - Expert or knowledge-based systems.
  - Tools for building expert and knowledge-based systems.
- Some of the natural language query systems now available are shown in Exhibit III-23. These systems can basically serve as front-ends to corporate data bases.
- The current user base of natural language query systems is quite small, but the market will achieve significant growth over the forecast period. Integrated products are beginning to appear, such as Microrim's CLOUT, that combine key elements of a natural language query system, linkage to a data base management system and aspects of an expert system.

# EXHIBIT III-22

## SPEECH SYNTHESIS/RECOGNITION PRODUCTS

VENDOR	PRODUCT	PRICE	FUNCTION/ CAPABILITIES
Borg Warner	Ufonic Voice System	\$495	Text-to-Speech Synthesizer
Computer Aids	Talking Workstation	\$375	Voice Synthesizing, Word Processor and Data Base Manager
Digital Equipment Corporation	DECtalk	\$4,000	Standalone Voice Synthesizer
Maryland Computer Services	Information through Speech (ITS) Microcomputer System	\$8,000-\$13,000	HP125 Turnkey Speech Synthesis System
MCE, Inc.	Voice Input Module	\$1,000	Voice Entry Board for Apple II
National Institute for Rehabilitation Engineering	Talking Typewriter	\$995-\$2,500	Speech Synthesizer with Extra-Large Type Displays
Scott Instruments	Shadow/VET	\$595	Voice Entry Terminal Board for Apple II Computers
Street Electronics Corporation	Echo II	\$130-250	Text-to-Speech Synthesizer for Apple II Computers
Vorax Inc.	Personal Speech System	\$395	Text-to-Speech Synthesizer

## EXHIBIT III-23

## NATURAL LANGUAGE QUERY SYSTEMS

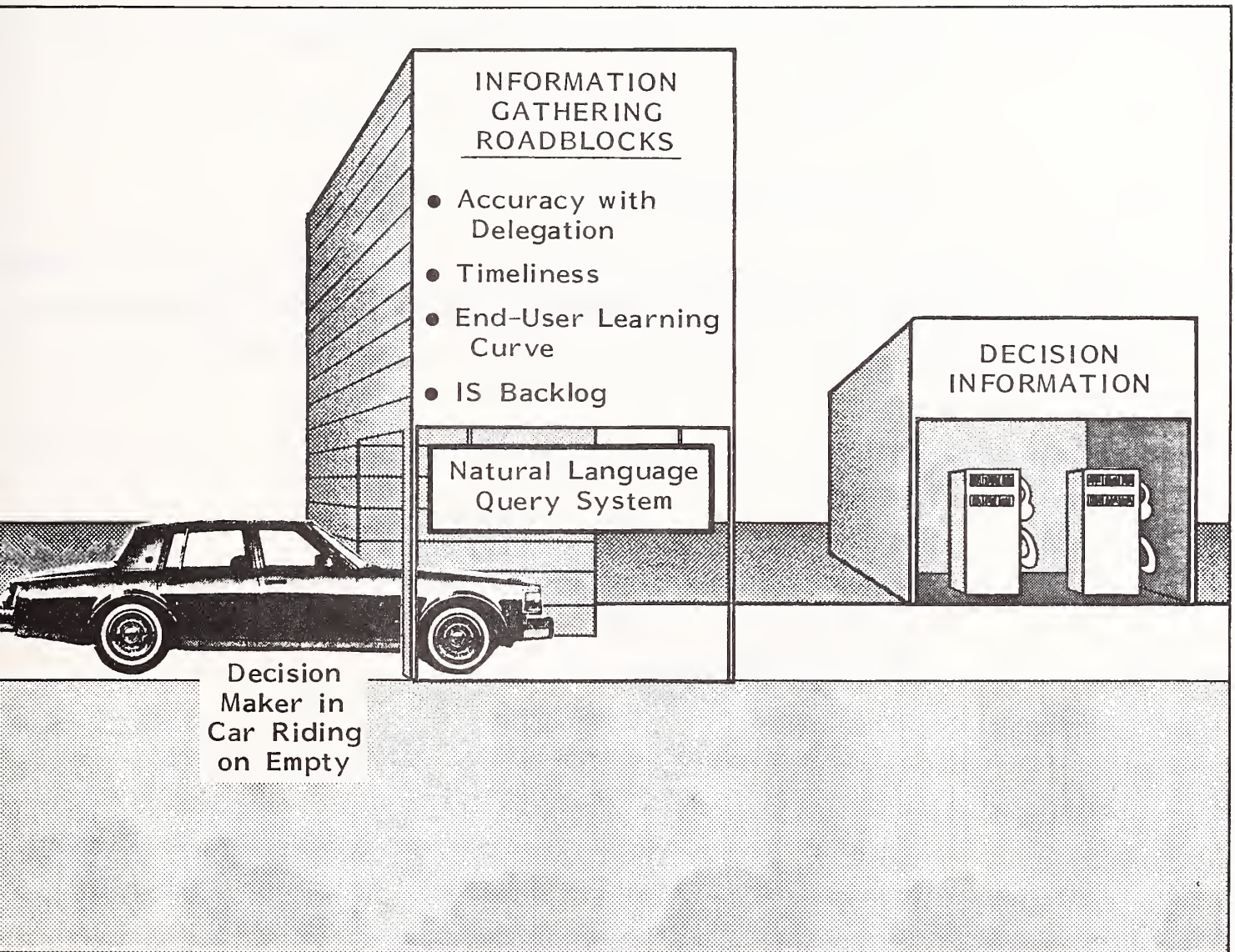
VENDOR	PRODUCT	HARDWARE	PRICE
Artificial Intelligence Corporation	Intellect	IBM 370	\$49,500 - \$69,500
Mathematica Products Group (Subsidiary of Martin Marietta)	English	IBM 370	\$12,000 - \$24,000
Frey Associates	Themis	DEC VAX	\$8,000 - \$24,000
Microrim	Clout	Various PCs	\$195

- Natural language query systems provide a step toward more user-friendly DSS interfaces.
  - However, these systems currently require a significant amount of manually keyed input, always loathsome to executive decision makers.
  - These systems, for the most part, also require significant computer resources, both in terms of memory and processing cycles.
  - To have a significant impact on decision makers, natural language query systems must be coupled with emerging voice recognition systems and technology.
  
- Exhibit III-24 shows some of the roadblocks facing decision makers in obtaining information from data bases and the natural language query systems that can avert these traditional roadblocks.
  - Natural language query systems can supplement, and in some cases replace, the more traditional information-gathering vehicles such as support staff and heavily "filtered" reports.
  - These systems will not replace other traditional sources of information for the executive such as:
    - . Telephone conversations.
    - . Meetings.
    - . Staff interaction.
    - . Personal networks.



EXHIBIT III-24

DSS ROLE OF NATURAL LANGUAGE QUERY SYSTEMS





- In fact, several recent psychological studies have indicated that decision making through electronic means (electronic mail for example) is more difficult than face-to-face decision making.
- Another significant branch of AI is the development of tools for building expert and knowledge-based systems. These include:
  - Hardware for programming in symbolic languages such as LISP and PROLOG.
  - Expert-system generators.
- Expert or knowledge-based systems are computer-based "programs" that make original judgments based on general facts. These systems are usually resident on large, powerful and expensive mainframe or special purpose computers.
  - The basic functions of expert systems are pattern matching and deducting.
  - Such systems usually require extensive interaction between an expert knowledgeable in a given field and a computer scientist able to define the rules of the system.
  - Such systems may take many months or even years to develop.
  - Expert systems are characterized by being able to handle effectively problems that do not have an algorithmic solution.
  - Such systems have traditionally been in the public domain, having been developed in the academic environment with publicly funded research. Within the past two years however, expert systems research and development has been affected by vendors seeking early market opportunities.

- Exhibit III-25 compares the functions of expert systems with those of a more "traditional" DSS. Expert systems in support of decision making:
  - Do not automatically make or implement decisions for executives, but provide possible solutions and alternatives.
  - Delineate the reasoning process used to arrive at those solutions.
  - Combine analytical and intuitive reasoning.
  - Have the capacity to learn from past decisions.
- Expert systems for decision making have been developed for four main application areas:
  - Resource allocation.
  - Problem diagnosis.
  - Scheduling and assignment.
  - Information management.
- Exhibit III-26 names several of the vendors of expert-system hardware. There have been a number of recent developments that indicate increasing levels of vendor activity with regard to such hardware.
  - This equipment, through its LISP or PROLOG compilers, is able to interpret symbols instead of alphanumeric instructions. Some of the earliest examples of artificial intelligence were demonstrated using such equipment.

# EXHIBIT III-25

## EXPERT SYSTEMS CONTRASTED AGAINST TRADITIONAL DSS

FUNCTION	EXPERT SYSTEMS	DSS
Decision-Making Support	Active: Draws Conclusions Proposes Alternatives	Passive: Only Returns Data, Usually in Summary Form
Reasoning Process	Analytical and Intuitive Flexible	Analytical Only Rigid
Ability to Learn	Yes	No
Reasoning Audit Trail	Visible	Hidden
Characteristics of Problems To Be Solved	Specific, Unique Details, Structured	General Relationships
Data	Knowledge Base Symbolic Unstructured Dynamic Can Be Incomplete	Data Base Arithmetic Structured Rigid Must Be Complete

## EXHIBIT III-26

## EXPERT-SYSTEM HARDWARE

VENDOR	EQUIPMENT	PRICE
Lisp Machine, Inc.	Lambda Lambda 4 X 4/+	\$66,500 \$45,000
Symbolics, Inc.	3600	\$59,000 - \$84,000
Xerox, Inc.	1108 (Dandelion) 1132 (Dorato) 1100 (Dolphin)	\$25,000 - \$50,000 \$150,000
DEC	VAX	
Tektronix, Inc.	4404 Artificial Intelligence System	\$14,950
Texas Instruments	Explorer	\$52,000 and up
Perq Systems Corp.	Perq AI Workstation	\$40,000

- Many of the current expert systems and expert system generators are developed in either the LISP or PROLOG languages.
  - Sales of such hardware are shifting away from the academic and research environments toward commercial companies. Seventy-five percent of LISP Machine, Inc.'s products were delivered to the commercial environment compared with only 25% in the previous year.
  - More manufacturers are entering into AI machine production and a number more are contemplating such moves. A driving factor behind this is the emerging power and capacity problem associated with expert systems and other artificial intelligence applications on the more traditional computer hardware.
  - Conversely, vendors such as Data General, Digital Equipment Corporation, and IBM are now providing LISP processing capabilities on the more traditional hardware systems, including the ECLIPSE, VAX and 370/4300, in an effort to target a broader user base and widen AI capabilities.
- Some examples of expert-system generators are shown in Exhibit III-27.
  - One of these, EXPERT-EASE, a "user friendly" expert-system generator for personal computers, has already found applications in a variety of industries. The system, which is one of the few to use inductive reasoning, allows an expert in a given field to develop an expert system without the aid of a computer scientist. Some of the applications of EXPERT-EASE include:
    - A system to diagnose operating faults in machinery and equipment in a factory, and recommend appropriate preventive maintenance and repair.



## EXHIBIT III-27

## EXPERT-SYSTEM GENERATORS

VENDOR	PRODUCT	HARDWARE	PRICE
Expert Systems, Inc.	EXPERT-EASE	IBM PC, DEC Rainbow, Victor Technologies 9000	\$125 \$2,000
Teknowledge	M.1 S.1	IBM PC Xerox 1100 & 1108 and DEC VAX	\$12,500 \$50,000 - \$80,000
IntelliCorp	Knowledge Engineering Environment (KEE)	Symbolics 3600 Xerox 1100 Xerox 1108	\$60,000
Texas Instruments	Personal Consultant	TI Professional Computer	\$3,000
Inference Corp.	Advanced Reasoning Tool	Symbolics 3600 Lisp Machine DEC VAX	\$48,000 - \$60,000

- A system to gather knowledge from managers within a purchasing department that will allow subordinates to make the same high-quality decisions as the managers.
- A system to disseminate corporate travel policies for specific locales, trip purposes, etc.
- An example of an expert system developed with EXPERT-EASE is included as Appendix G.
- More specific examples of expert systems are reflected in Exhibit III-28. It should be noted that each of these expert systems serves highly specific applications.

### 3. FUTURE ROLE OF AI IN DECISION MAKING

- As is true with decision support systems in general, there will be increased use of artificial intelligence in support of decision making in the future.
- AI is in the early stages of providing tools to end users; the next decade will begin to reveal AI applications reaching into many business areas.
- However, AI as a concept will not gain as fast an acceptance in corporate management as has, for instance, the personal computer. Decision making will be simplified because of the availability of better information. The human factor will continue to be a prime consideration in reaching final decisions.
- One of the most promising applications of AI and expert systems will be their capabilities as knowledge retainers.
  - One or two principal individuals often hold the key to company operations and the decisions associated with these responsibilities. AI and

# EXHIBIT III-28

## EXAMPLES OF EXPERT SYSTEMS

PRODUCT / SYSTEM NAME	FUNCTION
TAXADVISOR	Tax Planning
AUDITOR	Auditing - Assesses Allowance for Bad Debts
MYCIN	Diagnoses Certain Infections and Prescribes Medication
SACON	Structural Analysis
TICOM*	Modelling and Evaluation of Internal Financial Control Systems
EDP AUDITOR*	Auditing of Advanced Data Processing Systems

\*Under development.

expert systems will enable others to access this knowledge in the absence of these individuals.

- Such systems can be made even more powerful since they can be used to integrate many sources of knowledge into a single-source system, as well as distribute this knowledge to a wide body of people.
- The next five years will continue to be an era of exploration rather than of widespread AI applications.
  - Technology and human behavioral patterns will slow AI growth except in high technology and leading-edge companies.
  - AI will generate changes in how business is transacted, but their impact cannot as yet be easily determined. A short time ago, many analysts predicted that eventually many people would be working at home because of the availability of personal computers and terminals, and their ability to communicate with a large host system. The "high tech - high touch" MEGATREND refutes this argument since people have demonstrated a continuing need for human interaction.
  - However, artificial intelligence--its technologies, developments, applications and results--will eventually reach nearly everyone.

#### E. USER DEVELOPMENT STAGES AND PROFILES

- As with most other types of information systems, there are varying degrees of sophistication concerning decision support.
  - Varied levels of sophistication present few problems and will contribute to a more dynamic environment.

- The relative infancy of DSS and the rapidly changing technology will present challenges to most IS managers.
- In order to segregate the various user environments, three levels of sophistication will be defined as well as two different technical development thrusts. The three sophistication levels or DSS stages are as follows:
  - Stage I - Early DSS user.
  - Stage II - Maturing DSS user.
  - Stage III - Fully mature DSS environment.
- Exhibit III-29 lists some of the traits associated with an early user of decision support systems. Not all companies are at this level, but many industry segments will have begun experimenting with decision support, even if only using a simple spreadsheet package on a personal computer.
- Until recently, the early stage DSS user could most often employ planning models in a remote computing services environment. The increasingly widespread use of personal computers is altering this trend, as users move from an RCS environment to in-house standalone PCs, or integrated workstations for slightly more advanced users.
- The user in the early stage is usually a financial analyst and is often familiar with use of either a timesharing terminal or a standalone personal computer.
- The data used at this stage is commonly entered manually into the DSS by the ultimate end user. Companies at this stage do not usually have a centralized data base and most often are still in the process of implementing their base-line application systems; they do not typically have an information center.



## EXHIBIT III-29

### STAGE 1 – EARLY DSS USER CHARACTERISTICS

- Running Modeling Applications in an RCS Environment
- Initial Applications Basically in Financial Planning and Analysis
- Main User Is Financial Analyst and Is "Computer Literate"
- Data Is Manually Entered
- No Information Center at Company
- Have Few, if any Personal Computers
- Have One or Two Decision Support Products
- DSS Applications Are Basically Standalone
- Still Developing Baseline Support Systems

- Expenditures for decision support products and services at this level are easily segregated from other IS expenditures since they are typically limited to:
  - One or two software packages.
  - A finite number of personal computers and no dedicated personnel.
  - Easily accountable RCS expenditures.
- The early DSS user usually concentrates on learning one or two decision support tools. Some of the tools found in Stage I users include:
  - Personal computer software packages such as VisiCalc and Lotus 1-2-3.
  - RCS software such as EMPIRE and EIS.
- Companies or departments within companies usually spend approximately one year in this stage before advancing to the second stage of maturing DSS user.
  - It is important to understand that there may be multiple levels or stages of DSS users within a single corporation and the IS manager may be required to service all stages simultaneously.
  - Exhibit III-30 reflects some of the characteristics evident in maturing DSS functions.
  - During the maturing DSS phase, major corporate reorganizations have often recently occurred—for example, the establishment of a formal IS planning function, or a more general company reorganization.
- Reorganizations of businesses are occurring much more frequently as an increasing number of acquisitions and divestitures take place and the growing forces of end-user computing result in more functional reorganization.

## EXHIBIT III-30

### STAGE II - MATURING DSS USER CHARACTERISTICS

- Formal Corporate Planning and Analysis Function - Main DSS User
- Some Automatic Transfer of Data Available from Conventional Systems
- Early Data Base Environment Established
- Early Stage Information Center Established
- Standalone PCs Beginning to be Integrated into Mainframe
- RCS Applications Being Migrated In-House
- IS Skepticism and Rivalry of End-User Computing Apparent.
- Have a Relatively Large Base of Personal Computers
- DSS Application Base Still Basically Financially Oriented, but Rapidly Expanding
- DSS End-Users Are Usually Less Computer Literate than Stage I Users
- Have a Wide Variety of DSS Tools
- DSS Expenditures Becoming Less Apparent
- Users Begin to Require More Enhanced Reporting Capabilities Including Sophisticated Graphics

- An increasing number of companies are distributing their IS functions out to the principal operational unit involved, typically leaving a central corporate unit to handle standardized applications (accounting, personnel, etc.).
- A significant portion of the users approaching the advanced stages of DSS maturity have a functional senior management committee overseeing developments in their companies' data-processing facility. In many of these companies, the number one strategic priority was either end-user computing or decision support.
- Changes as reported above are causing increasing concern in traditional IS organizations in companies approaching the maturity stage of DSS evolution.
  - In a number of interviews there was strong rivalry evident between the traditional IS shop and the information center.
  - IS personnel in a number of companies were skeptical about widespread use of personal computers in solving broad business problems, but such skepticism is being quickly allayed.
- This second stage is also characterized by the development of automated data transfer from a functional application source to a decision support system, residing either on a mainframe or on an integrated PC or workstation.
- Traditional transaction-processing systems have evolved to the point where information is being processed from a data base management facility.
- During this phase the information center begins to be an established entry in many companies. This information center will:
  - Be a functional part of the IS organization, although often physically separate.

- Share IS mainframe hardware resources.
  - Have a number of standalone personal computers and appropriate personal computer software packages including a number of DSS tools.
  - Have a limited staff often composed of a manager, and one or two people with skills in packaged software or in customer support.
- This stage also marks the beginning of the establishment of micro-to-mainframe system linkages. Once established, these connections provide the DSS user with more current data as well as the processing power of the mainframe system.
    - Micro-based versions of traditionally mainframe-oriented DSS are beginning to be utilized more often than standalone micro-based DSS.
    - There are numerous companies in this study who have cost-justified and purchased a product resident on an RCS vendor's system in order to provide the same facilities but to reduce the incremental processing charges.
  - There is still some skepticism regarding end-user DSS and information centers, but the growing base of personal computers within companies as well as a fairly static reduction in the IS backlog has meant a lessening of uncertainty. In several companies, the information center provided IS with planning via DSS (budget analysis, project management, capacity planning, etc.), thus turning IS into an end user.
  - It is during this phase that the DSS "application" base begins to expand significantly. During the first stage, applications were limited to basic financial analysis most often on a standalone, single iteration basis. During this phase, DSS users begin to recognize the need to integrate many of their applications and also to begin consolidation of the data associated with them.



- End users during this stage are less computer literate than first-stage DSS users, simply because they do not have to be the "pioneers."
- At the same time, particularly through vehicles such as the information center and through increasing use, these end users are developing strong skills in one or two software tools.
- The number of software DSS tools, particularly in the microcomputer arena, has significantly increased during this stage.
  - In many companies the number of tools has grown so significantly that end-user data processing support organizations, including information centers, are no longer able to provide support for all of the software available.
- Some of the tools required by users in this stage include those that provide more enhanced reporting capabilities, particularly in the areas of integrated text, tabular, and graphic information.
- Finally, the maturing stage is characterized by the increasing inability of management to identify specific costs associated with pure decision support. This is the result of many factors, including:
  - Separate departmental (end-user) budgets that may or may not list such items as personal computer hardware or software acquisitions.
  - A traditional lack of a chargeback mechanism for functions such as information centers.
  - Difficulty in distinguishing the use of DSS tools (e.g., spreadsheets) for DSS-based applications from the same tools used for nondecision support functions.

- It is during this stage that two different DSS development thrusts begin to appear that are highly significant to the IS manager. It is important that these separate thrusts are understood since they involve very different types of hardware and software and they are typically developed by different organizations. Exhibit III-31 summarizes the differences between two DSS user types, planning and analysis users, and operational production system users.
- The primary differences between these two categories involves the types of decisions these systems assist in making.
  - The planning and analysis users, who are often associated with decision support, most often deal with longer term analysis, decisions, and strategies.
  - Operational production system users deal with near term decision making. A classic example of a DSS of this type is a MRP II-type manufacturing system that changes operational priorities and schedules based on ongoing actual events, and therefore uses live, up-to-date production data.
  - Planning and analysis users, on the other hand, generally use a subset of prior, historical data coupled with planned future data.
- The users in each of these categories are often of very different backgrounds.
  - Whereas the planning and analysis user may be any end user with some knowledge of computers, the typical operational production system user will have a more extensive, technical background in computers.
  - Often these individuals will at least have a programming background, and quite often will have in-depth backgrounds in management science or operations research.

# EXHIBIT III-31

## THE TWO DSS USER TYPES

PLANNING AND ANALYSIS USERS	OPERATIONAL PRODUCTION SYSTEM USERS
<ul style="list-style-type: none"> <li>● Actual Users May Be End Users or DP/MIS Personnel</li> </ul>	<ul style="list-style-type: none"> <li>● Actual Users May Be Programmers, Management Science or Operations Research Personnel</li> </ul>
<ul style="list-style-type: none"> <li>● Minimal Technical Knowledge Requirements</li> </ul>	<ul style="list-style-type: none"> <li>● Strong Technical Knowledge Required</li> </ul>
<ul style="list-style-type: none"> <li>● Software Packages Used Generally User Friendly</li> </ul>	<ul style="list-style-type: none"> <li>● Software Packages Require Significant Technical Knowledge and/or Abilities</li> </ul>
<ul style="list-style-type: none"> <li>● Applications Are Often Micro-Processor Based</li> </ul>	<ul style="list-style-type: none"> <li>● Applications Are Typically Developed for/on Mainframe Computers</li> </ul>
<ul style="list-style-type: none"> <li>● Applications Typically Entail Either Planning Future Activities or Analyzing Past Events</li> </ul>	<ul style="list-style-type: none"> <li>● Applications Typically Center on Ad Hoc Decisions Influencing Near-Term Direction</li> </ul>
<ul style="list-style-type: none"> <li>● Data Used Is Often a Subset of Prior, Historic Data</li> </ul>	<ul style="list-style-type: none"> <li>● Live Up-to-Date Production Data Often Required</li> </ul>

- The technical knowledge required is significantly greater for the operation production system user than it is for the planning and analysis user.
- Advanced technical knowledge is required because the hardware and software used by these two groups are at opposite ends of the data processing resource spectrum. Planning and analysis users use software tools that are generally considered "user friendly" and are often operational on a microcomputer. Lotus 1-2-3 is be one of the most frequently used tools for this user group.
- Operational production system users on the other hand develop most of their applications on mainframe computers with tools such as structured query language (SQL) and IMS data bases.
- As we enter Stage III of the DSS maturity cycle, the planning and operational groups continue their divergent paths: the planning and analysis user viewed more and more as a part of the end-user organization while the operational production system user becomes more firmly locked into the IS area.
- As we have seen, the first two stages in the DSS evolution have established a firm baseline for the participating firm. The characteristics of companies that have reached this level of sophistication are reflected in Exhibit III-32.
- While the first two stages of growth in DSS maturity are common for most industries and companies, differences will appear in third-stage companies because corporate traditions, politics and approaches to management as well as industry traits and characteristics will exert a strong influence.
- Companies within this stage have a large number of users throughout many areas of the corporation. These users include top-level management as well as clerical or production workers. In some companies researched throughout this study, executive-level management, including the president or chief executive officer, is a DSS user.

## EXHIBIT III-32

### FULLY MATURE DSS ENVIRONMENT

- Large Number of Users Throughout Corporation
- Wide Variety of DSS Applications Being Developed and Used
- Prototyping of Applications a Common Practice
- Large Number of Personal Computers in Use Integrated into a Mainframe
- Information Center Being Actively Used
- May have a "Gateway" Facility to Provide Common Entry Point
- Routinely Provide Production Data Base Updates
- Are Experimenting with Artificial Intelligence Tools and Applications
- Have Great Difficulty in Determining Total Expenditures for DSS
- May Have Fully Integrated Office Automation and IS Functions.



- With such a broad user base, it is a characteristic of this stage that there exists a wide variety of DSS applications evident in the company.
  - DSS applications are being developed that will be processed on a repetitive, recurring basis.
  - Evident in many third-stage companies is the propensity to develop more traditional MIS-type systems patterned after existing DSS applications. This usually occurs when a DSS application reveals some anomalies in a business function, detection of which can be built into a traditional production system.
  - The repetitive nature of some DSS applications often leads to increasing iterations of those applications in order to better refine the data and results.
- Another characteristic becoming more apparent in third-stage DSS users is the trend toward prototyping DSS applications prior to development of full functional systems.
  - Prototyping helps to determine whether a particular DSS application will prove of overall benefit to the corporation.
  - Fourth generation languages are most often used in prototyping new DSS applications.
- As previously mentioned, companies in a Stage III DSS environment often have a proportionately large number of personal computers. At this stage a majority of these PCs are also capable of being, or actually are, linked to a mainframe computer, or have that capability built-in.

- Personal computer use in these companies illustrates a wide variety of novel approaches to introduce end-user computing.
  - Several study participants have established executive personal computer "loaner" programs, that encourage personal computer use by senior management in a company.
  - In several of these companies the top executive in the organization had both a standalone (often portable) personal computer and a microprocessor linked to a mainframe system at his disposal. In some cases, this configuration was used to encourage the deployment and use of personal computers more than for actual functional use by these executives.
- Coupled with increased personal computer use, companies in this stage often have active, highly-utilized information centers that provide a significant amount of end-user computing requirements in terms of hardware, software, data security, and education and training.
    - Users within companies in this stage still identify data administration as a "personal" function rather than as the responsibility of another corporate entity.
    - The IC may provide facilities for the planning and analysis users, the operational production system users, or for both.
    - Depending on company size and overall processing requirements, the IC may, at this point, have a dedicated mainframe (or minicomputer) at its disposal.
  - Another significant trend was the efforts of corporations in this stage to begin integration of their DSS facilities and services. Two distinct trends are observable.

- Some third-stage (or late second-stage) companies are looking for a single vendor to provide an integrated DSS environment. This would eliminate the problems inherent in integration of multivendor DSS applications.
- The second thrust is with companies looking to provide a single entry point (gateway) to all of their diverse DSS software. While this may be the more difficult technical approach, it is probably the more practical since few vendors currently offer or plan to build software that is able to meet the total requirements of all DSS developers and users.
- As a matter of routine, companies in this stage provide separate data bases for DSS users, and provide continuous concurrent updates to resident data in these files.
- As a corporation progresses through the three stages of DSS maturity, increasing responsibility to provide DSS capabilities will be placed on the IS organization. This is a result of:
  - The lessening of the initial novelty of end users developing DSS applications on personal computers.
  - An increasing desire on the part of end users to get a problem solved without having to learn how to use DSS applications or system software.
  - The increasing complexity of DSS applications requirements, requiring more sophisticated development techniques, production data, etc.
  - The rapidly advancing technology, inhibiting end-user progress unless significant advances are made in ease-of-use of DSS software.

- Companies at this stage are also at the leading edge in two main areas:
  - These firms are beginning to address seriously the issue of integration of data processing and office automation. Although no prevalent patterns are yet apparent, the search for integrated solutions points to a trend of companies looking for a single-source solution to high technology problems.
  - These firms are also experimenting with practical applications of artificial intelligence. These efforts would have been in the area of natural language queries, but a number of survey firms classified as Stage III DSS users have experimented with expert systems and expert-system generators.
- Finally, a characteristic of companies in this stage is the almost complete inability to isolate DSS expenditures from other IS-related expenditures or even from other general operating expenses. This is a natural extension of the second stage inability to distinguish DSS expenditures. The increasing distribution of DSS functions and processing will increasingly hamper such expenditure segregation.
- Since decision support systems are furthermore an application of high technology, it is also important that the relative sophistication of the users be addressed. This can best be accomplished by looking at company sizes that can be divided into four business classes, as follows:
  - Class I - Extended Fortune 5000, encompassing the 750 largest corporations from all industries;
  - Class II - The second 500 from the Fortune list plus the top 100 non-industrials for each of the main business categories, making the Class II population 1000 companies;

- Class III - Comprised of the Fortune 1000-2000 ranked corporations plus the next 250 banks, the next 450 insurance firms, the next 850 service organizations and the 350 next largest miscellaneous businesses;
  - Class IV - Everyone else.
- Within each of these classes, the overall levels of maturity with respect to development and use of decision support systems will vary slightly by type of company. Exhibit III-33 shows the percents for the top three classes of the DSS environment now and in 1989.
  - Exhibit III-33 indicates that 60% of Class I companies (the Extended Fortune 500) are at an early stage of DSS development, while 15% can be considered as fully mature. Quite naturally, as company size decreases, there will be evidence of less fully mature companies with respect to DSS.



# EXHIBIT III-33

## DSS MATURITY BY BUSINESS CLASS

DSS MATURITY STAGES	1984 BUSINESS CLASSES		
	I	II	III
I (Early)	60	70	80
II (Maturing)	25	20	15
III (Fully Mature)	15	10	5

## PERCENT OF COMPANIES IN EACH CATEGORY

DSS MATURITY STAGES	1989 BUSINESS CLASSES		
	I	II	III
I (Early)	10	30	40
II (Maturing)	30	30	40
III (Fully Mature)	60	40	20



#### IV VENDOR ANALYSIS



## IV VENDOR ANALYSIS

### A. VENDOR PERCEPTIONS

#### I. OVERALL DSS-RELATED

- The forty-one vendors interviewed during the course of this study offer the full range of DSS products from hardware to software and to remote computing services. The complete list of vendors interviewed is included as Appendix C.
  - A list of some of the vendors of DSS software products for mainframe and mini-computers is included as Exhibit IV-1, while Exhibit IV-2 depicts some of the software products for personal computers.
  - These lists are by no means intended to be complete lists of all products available since such a list would have to be updated on an almost daily basis.
  - As can be seen from the functional characteristics listed, these products span a wide range of functions and an even wider range of prices.
- Vendors and users have many diverse opinions and definitions as to what constitutes a decision support system.



# EXHIBIT IV-1

## DSS SOFTWARE PRODUCTS - MAINFRAME/MINICOMPUTER

VENDOR	PRODUCT	LICENSE FEE/ PRICE	FUNCTION/ CAPABILITIES
Access Technology, Inc.	Supercomp-Twenty (SC-20) 20/20	\$950- \$9,700	Spreadsheet, Graphics, Text Processing, Project Scheduling
Applied Data Research	ADR/Empire	\$45,000 - \$60,000	Data Handling, Reporting, Modeling, Graphics, Statistical Analysis
Artificial Intelligence Corp.	Intellect	\$49,500- \$69,500	Natural Language Query System/Interface
Ashton-Tate	dBase Answer	\$45,000+	
Boeing Computer Services	EIS	\$55,000- \$160,000	Reporting, Graphics, Modeling Forecasting, Data Base Management, Statistics
Chase Decision Systems	XSIM	\$50,000	Data Management, Reporting, Graphics, Financial Modeling, Econometrics, Statistical Analysis
Computer Language Research, Inc.	Spreader	\$150,000	Tax Processing
Comshare	System W System W Plus System W Distributed	\$65,000- \$100,000	Graphics, Forecasting, Statistics

EXHIBIT IV-1 (Cont.)

DSS SOFTWARE PRODUCTS - MAINFRAME/MINICOMPUTER

VENDOR	PRODUCT	LICENSE FEE/ PRICE	FUNCTION/ CAPABILITIES
Cullinet	OnLine English		Natural Language Query System
Desk Top Financial Solution	DT/FPS	\$3,750	Office Automation
Economic Sciences	EMS	\$50,000- \$150,000	
EPS	FCS-EPS	\$40,000- \$120,000	Planning, Graphics, Fore- casting, Analysis, Data Management, Reporting
Execucom Systems Corporation	IFPS IFPS/MINI	\$64,000 \$40,000	Business Language, Reporting, Modeling
Frey Associates	THEMIS		Natural Language Query
Lloyd Bush & Associates	MODEL	\$9,000- \$100,000	Reporting, Planning, Modeling, Financial Requirements
L&L Products, Inc.	SPREAD	\$8,000- \$24,000	Modeling, Reporting, Forecasting
Management Decision Systems	Express	\$50,000	Modeling, Reporting, Forecasting
Management Sciences America	Forecasting and Modeling System		

Continued

# EXHIBIT IV-1 (Cont.)

## DSS SOFTWARE PRODUCTS - MAINFRAME/MINICOMPUTER

VENDOR	PRODUCT	LICENSE FEE/ PRICE	FUNCTION/ CAPABILITIES
Manufacturers Hanover Trust Co.	Treasury Management Service	\$1,500-\$2,000 per Month	Cash Management
The MegaGroup	MegaCalc MegaFile MegaGraph	\$15,000-19,000 \$4,000-5,000 \$4,000-5,000	Spreadsheet, Graphics, Data Management
Oxford Software	MaxiCalc II	\$9,000-12,000	Graphics, Worksheet, Reporting
Ross Systems	Maps/Model	\$23,000- \$30,000	Financial Modeling
SAS Institute	SAS	\$7,900- \$32,000	Statistical Analysis, Data Mana- gement, Graphics, Reporting, Computer Performance Evalua- tion, Modeling
SEGRA International	CPL Tactix	\$85,000	Relational Data Base Like Data Management, Financial Analysis, Graphics, Reporting, Spread- sheet, Modeling

EXHIBIT IV-2

DSS SOFTWARE PRODUCTS - PERSONAL COMPUTER

VENDOR	PRODUCT	LICENSE FEE/ PRICE	FUNCTION/ CAPABILITIES
Access Technology, Inc.	20/20	\$200-950	Spreadsheet, Graphics, Data Base Management, Text Processing, Project Scheduling
Applied Data Research	PC Empire	\$600	Data Handling, Reporting, Modeling, Graphics, Statistical Analysis
Artificial Intelligence Corp.	Intellect Micro-to-Mainframe Link		Natural Language Link to Full Mainframe System from PC
Ashton Tate	dBase II dBase III dBase III Multi I Framework Friday	\$495 \$695 \$995 (First) \$695 \$295	Data Base Management, Integrated System
Boeing Computer Services	EIS Workstation	\$300-6,000	Reporting, Graphics, Modeling, Forecasting, Data Base All Through Mainframe Link
Computer Language Research, Inc.	Microtax Spreader	\$3,000	Tax Processing
Comshare	Micro W	\$200	Distributed Functions of System W

Continued

EXHIBIT IV-2 (Cont.)

DSS SOFTWARE PRODUCTS - PERSONAL COMPUTER

VENDOR	PRODUCT	LICENSE FEE/ PRICE	FUNCTION/ CAPABILITIES
Context Management Systems	New Context MBA Corporate MBA	\$695-895	Modeling, Graphics, Data Base, Word Processing, Communica- tions, Reporting
Cullinet	PC Software (Golden Gate)	\$25,000-40,000	Spreadsheet, Graphics, Financial Modeling, Document Processing, Personal Data Base, Electronic Mail
Control Data	*VisiOn		Reporting, Financial Planning, Modeling
EPS Inc.	Micro FCS		
Execucom	IFPS/Personal	\$1,500	Graphics, Reporting, Communi- cations, Modeling
Ferox Microsystems	Encore	\$695	Graphics, Reporting, Statistical Analysis, Spreadsheet, Modeling, Mainframe Interface
Fox and Geller	OZ	\$495	Management Control
Human Edge Software			
L & L Products, Inc.	Spread	\$500	Modeling, Reporting, Forecasting



## DSS SOFTWARE PRODUCTS - PERSONAL COMPUTER

VENDOR	PRODUCT	LICENSE FEE / PRICE	FUNCTION / CAPABILITIES
Lloyd Bush and Associates	Model	\$595-995	Reporting, Planning, Modeling, Financial Requirements, Graphics
Management Decision Systems	Express Mate	\$450	Reporting, Modeling, Planning
Manufacturers Hanover Trust Co.	Treasury Management Service	\$1,500-2,000 Per Month	Cash Management
Micro Data Base Systems	MDBS III Knowledgeman	\$500	
Micro MRP, Inc.	MAX	\$18,000	Manufacturing Resource Planning
Microrim	R:Base 4000	\$495	Relational Data Base Management System
	Clout	\$195	Nautral Language Query System
OfficeSmiths	OfficeSmith	\$5,000-18,000	
Prime	MultiPlan		Advanced Workstation
Ross Systems	Maps/Model		Financial Modeling
SEGRA International	CPL-Tactix	\$2,000	
Software Arts	*VisiCalc VisiCalc 4	\$99-220 \$250-400	Analysis, Graphics, Reporting, Spreadsheet
Sorcim/IUS	SuperCalc 1, 2, 3	\$195-395	Spreadsheets, Graphics, Data Management

- Vendors define DSS in conjunction with the products and services they offer. The definitions therefore include mention of programs and systems, data bases, financial applications, graphics, modeling, expert systems, etc.
- Some vendors only refer to DSS in connection with personal computers while others believe that DSS would turn decision makers into "para-programmers."
- Many vendors define DSS as totally end-user-oriented, most likely derived from the use of spreadsheet packages on personal computers.
- Many of the DSS vendors offer only a single product or similar versions of the same product for mainframe and for personal computers. Also, in many instances the products are recent offerings without widespread utilization.
- Vendor optimism regarding the future of DSS products and services is shown by the number of vendors predicting large market shares for their particular product line in 1989.
- With regard to the future, a majority of the vendors interviewed (57%) felt that there would be fewer vendors marketing DSS products in 1989. However, a majority of the vendors also anticipate that there will be more DSS products available in the near future.
- These contrasting trends can be attributed to a number of factors including:
  - A general feeling that a "shakeout" is beginning to occur in the software industry in general and more specifically in DSS software.
  - A sense that many products, particularly for personal computers, will continue to be developed by small, "cottage type" companies hoping to

make a big hit in the marketplace, even though the success rate of such companies might be low.

- The financial reality that developing and marketing a new system can be very expensive. One vendor estimated that it cost them over \$7 million to develop and begin marketing a new software product.
  - The impression that it's currently a one company/one product environment, coupled with a view that there will be increasing specialization within vertical industries.
  - A feeling that there will continue to be an infusion of new vendors and products for the next few years, followed by a decrease in both categories in the more distant future.
  - A shortening of the life cycle for applications. Previously software packages lasted a number of years, but with so many vendors and potential vendors rapidly producing more advanced and sophisticated software, earlier products quickly became obsolete, particularly for PC software.
- The life expectancy for software has decreased so significantly that it is now anticipated that most companies will have an entirely new set of DSS software products within the forecast period. While mainframe software products now have an anticipated life of between 36 and 42 months, personal computer packages have a life expectancy of only 24 to 30 months.
  - Regarding their own products and companies, the vendors' views generally reflected the relative newness (and therefore the unknowns) of their potential markets. Exhibit IV-3 reflects some of the vendors' major concerns.
  - A significant vendor concern is determining the proper marketing approach for distribution of their products.

## EXHIBIT IV-3

### DSS VENDOR CONCERNS

- Proper Product Positioning
- Proper Product Marketing Approach
- Appropriate Pricing Structure
- Market Maturity
- User Education
- Technical Product Developments
- Technology Issues

- Vendors are searching for the appropriate distribution channels, including investigations into dealerships, joint marketing arrangements, and other avenues for distribution.
- The vendors are also concerned with establishing an appropriate pricing structure for their products. This comes at a time when the average price for personal computer software has dropped from a 1982 level of around \$500 to the current level of around \$300.
  - Product prices, even from the same generic type of product, have wide variances as reflected in numerous exhibits in this report. Consequently the question of an appropriate price has become a problem.
  - Particularly in the software area, there has been a tendency to price according to the potential customer's payment ability rather than according to a set price schedule.
- The vendors are attempting to develop mature markets for their products, although the field is changing more rapidly than the market is maturing.
- Another concern of the vendors, related to the previous marketing issue, relates to the buyers and users of their products.
  - Many of the vendors feel that the users/buyers of their products require significant education as to the capabilities, competition and potential of decision support products.
  - This concern is especially important to the vendors of products that are not as well known as software such as Lotus 1-2-3, and that are not receiving as much free publicity in trade and business publications.



- The education issue is even more important to vendors who offer artificial intelligence products, including expert systems and expert-system generators, since user impressions of such product categories are even more diverse and misunderstood.
- Another major concern of the vendors are developments concerning the technical aspects of their products.
  - Numerous vendors sense that ease-of-use is a particularly significant product feature and that their products will have to be made easier to use in order to expand their sales. However, these vendors are also concerned with the development costs associated with making their products easy to use.
  - Micro-to-mainframe linkage is also of concern to a significant number of the vendors. Several vendors who offer DSS software for mainframe computers are concerned that their companies might be unable to develop micro-based products or micro linkages for their mainframe products.
  - A trend is apparent in the users surveyed that emphasized the benefits to vendors with micro and mainframe versions of their products. DSS users with mainframe versions of a particular DSS software product quite naturally showed strong propensities to purchase the micro version.
  - Integration of product capabilities is an issue for several reasons. Most vendors currently see a need to provide fully integrated DSS tools including financial modeling, data base management, graphics, natural language inquiries, etc. in one system. This appears to be more of a short-term goal in order to keep their position in the highly competitive DSS marketplace, rather than a long-term product strategy.

- The vendors also see a need to have products that can interface with a wider variety of complementary systems (i.e., inquiry modules should be able to extract data easily from most data base management systems). This need will become more pronounced as product differentiation becomes a more pervasive vendor strategy.
  - Vendors are also concerned with the relevance and completeness of their products. Several vendors were uncertain whether their products met user needs and requirements.
  - Finally, several vendors are concerned with areas in which their specific products need to be strengthened (i.e., enhanced report writing or data base facilities).
- Of the DSS vendors surveyed, 60% responded that they did not target any specific market. Of those who do target specific markets, 50% target the financial markets including banking and insurance. This is to be expected given the currently predominant tendency to use decision support systems for financial applications.
  - Sixty-four percent of the vendors do target specific cross-industry applications. Of these, the planning and analysis and accounting areas are most frequently the market focuses. Again, given the current nature and use of DSS products, this is not surprising. It does, however, point to the fact that there are many existing areas within companies where the potential uses of decision support systems have not been fully explored.
  - Sixty-one percent of the vendors target specific users in the various industry sectors.
- Very few of the vendors identify an IS group as a marketing target. This is indicative of the currently strong vendor identification of DSS with end users.

- Financial personnel and others within planning functions are most often identified as potential purchasers.
- The vendors' perceptions as to why their products are successful vary widely and are often directly opposite to their major concerns involving their product.
  - A significant number of vendors identify the most prominent selling point for their product as its "ease-of-use."
  - Ease-of-use, however, is an area where most of these same vendors feel their products need significant enhancement.
  - Rivaling ease-of-use as a selling point is the professed processing power of the vendor's product. Special features and functional integration are the next most prominent selling points.
  - An issue of great concern for many vendors is the integratability of their product, while many of these same vendors say that this feature is precisely what sells their product.
- The vendors believe that the most important activity or function to be included in a DSS environment is data base management.
  - This will remain the top issue for vendors over the next two to three years. The apparent feelings are that this is an area where many of the vendors have significant product weaknesses.
  - The only changes perceived by the vendors in terms of top DSS issues functions are the increasing importance of telecommunications and networking. The full list of top DSS issues functions as perceived by the vendors is included in Exhibit IV-4.

# EXHIBIT IV-4

## IMPORTANT DSS ACTIVITIES AND FUNCTIONS - VENDOR PERSPECTIVE

CURRENT	IN 2 to 3 YEARS
1. Data Base Management	1. Data Base Management
2. Data Acquisition	2. Data Acquisition
3. Self-Documenting Modeling Language	3. Self-Documenting Modeling Language
4. Report Generation	4. Report Generation
5. Spreadsheet	5. Graphics Capability
6. Graphics Capability	6. Spreadsheet
7. Financial Consolidation	7. Financial Consolidation
8. Forecasting Capability	8. Telecommunications
9. Word Processing	9. Financial Functions
10. Financial Functions	10. Networking

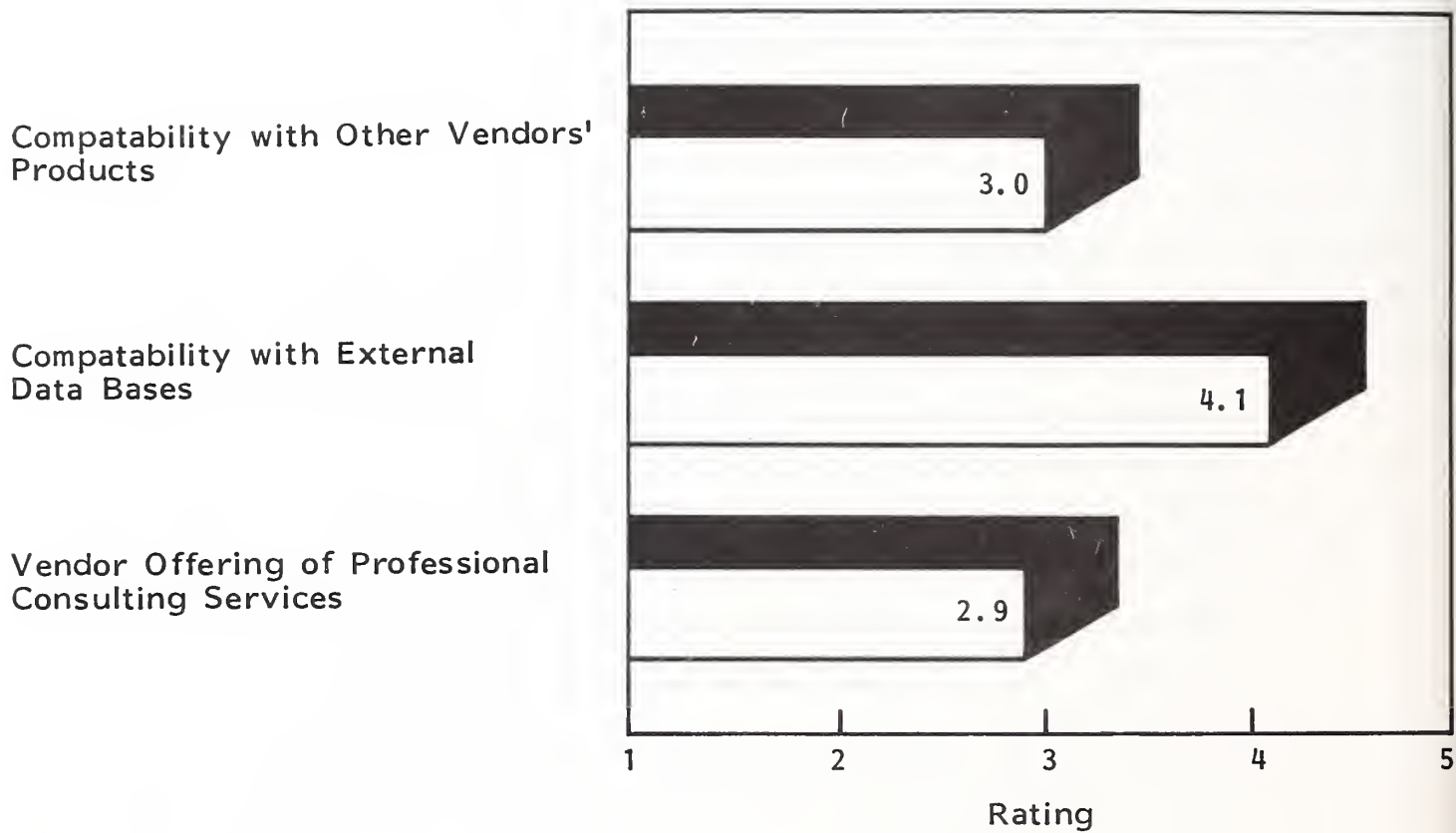
- When contrasted against the users' perceptions of top DSS functions (see Exhibit III-7), only minor differences are perceived, which indicates that, at least for the near future, vendors should be fulfilling the users' conceptual needs.
- The vendors again have widely divergent views when addressing the issues of the role of the information center and of the requirements for micro-to-mainframe links.
  - Some vendors foresee no special requirements concerning their products, while others indicate that all the requirements connected with these issues are currently satisfied by their company and their products.
  - Several of the vendors have a total lack of knowledge regarding these concepts, while a few others feel that such items are ephemeral concepts or fads.
  - There is also some confusion regarding implicit definitions of the information center, evidenced by several vendors identifying the IC as an IS management function that will take control away from end users.
- Vendors generally see some of the same factors as being as important for micro-to-mainframe links and information centers as for DSS products in general. These include such factors as:
  - Ease-of-use (user friendly).
  - Functional integration.
  - Speed/power.
  - Transportability.



- The micro-to-mainframe linkage and IC concepts also brought to the surface the major functional issue of data security and control.
  - Vendors have strong concerns regarding the requirements generated by allowing access to central corporate files. Micro-to-mainframe links and information centers will give users easy access to vast amounts of data. The problem as foreseen by the vendors will be to keep this data secure.
  - A further problem exists where data is both down- and up-loaded. The auditability of the data then becomes a key issue. Such import/export of data will involve significant vendor efforts for effective resolution.
- Vendors have either strongly positive or strongly negative views as to whether or not it is important for each vendor's product/service to be compatible with other vendors' products/services. Forty-nine percent of the vendors think the issue is of little importance, while 51% think of it as very important. In terms of actual vendor responses, with 1 representing little importance and 5 representing maximum importance, cross-product compatibility generated a response factor of 3.03, indicative of medium importance as a vendor issue, as shown in Exhibit IV-5.
- A number of vendors believe, however, that cross-product integration and interfacing is becoming increasingly important. Two significant trains of thought are apparent in this regard.
  - These vendors feel that integration is important for micro-based products, but not mainframe products. This is because mainframe systems are the responsibility of the IS personnel, who should be able to accomplish any required integration. Even in an information center environment--typically centered around a mainframe but end-user controlled--IS staff would probably be available to interface diverse systems.

## EXHIBIT IV-5

### IMPORTANT DSS PRODUCT FACTORS - VENDOR PERSPECTIVE



Rating: 1 = Low Importance, 5 = High Importance.

- Most vendors feel that it is necessary to provide integrated capabilities, but not through interfacing with every other vendor's products. For instance, it is necessary for a spreadsheet program to be able to interface with a data base management system and an inquiry system and a modeling language, but it is not necessary that these products belong to the same vendor or that the system interface with more than one of each type of associated program/capability.
- In conjunction with this, several vendors believe that their products should be able to interface with Lotus 1-2-3, since this software is currently prevalent in so many companies.
- Integration is an aspect that is of high importance to users, as previously indicated in the survey. Several corporations have used their IS or information center staff to build user-friendly gateways to the diverse DSS software that users have on their systems.
- Linking decision support systems to external data bases was deemed to be of fairly high importance to vendors. The weighted average response resulted in a 4.1 figure.
  - Many vendors stressed the critical importance of this capability, particularly in micro-based products, since such products generally have more limited data capacities.
  - Many vendors also sense that most user companies do not want to maintain such a data base themselves, considering the cost of maintaining the types and volumes of data usually found in such data bases.
- The need to provide professional consulting services evoked a wide range of response from the vendors. Although only one more vendor ranks consulting services as a low importance item than those who rank consulting as of

highest importance, the resulting weighted average came to 2.9, which is hardly a full endorsement of such services.

- The vendors who rank professional consulting as of low importance tend to be vendors with a limited product line who generally also classify their products/services as easy-to-use or user friendly, therefore not requiring use of consultants.
- Those on the high end of the importance scale see the following types of professional service offerings as being important:
  - . Training and education.
  - . Hotline support.
  - . Technical support.
  - . System development.
  - . Application consulting.
  - . Presales support.
  - . Postsales support.
- The vendors tend to stress the importance of professional consulting more than do end users. In fact, end users seldom saw the need for substantial use of consultants within any industry segment for defining, building or maintaining DSS applications. Vendors cite the costs of labor and its potential payback measured against the potential payback for hardware and software products as the prime reason for not providing professional consulting, while users generally view in-house resources as of primary importance in developing state-of-the-art applications.

- There are some indications that these trends will change, particularly in conjunction with decision support systems or artificial intelligence and associated expert systems.
  - A number of vendors are using consultants in a presales mode. This is particularly important where the products' capabilities, possibilities and potential uses can be misunderstood.
  - While the number of people who use spreadsheet-type products has been rising significantly, the personnel with knowledge of full-function DSS, artificial intelligence and expert systems will remain quite low.
  - When micro-to-mainframe links and information centers are considered, the technical expertise necessary to support that function may be unavailable in-house.

## 2. VENDORS AND ARTIFICIAL INTELLIGENCE

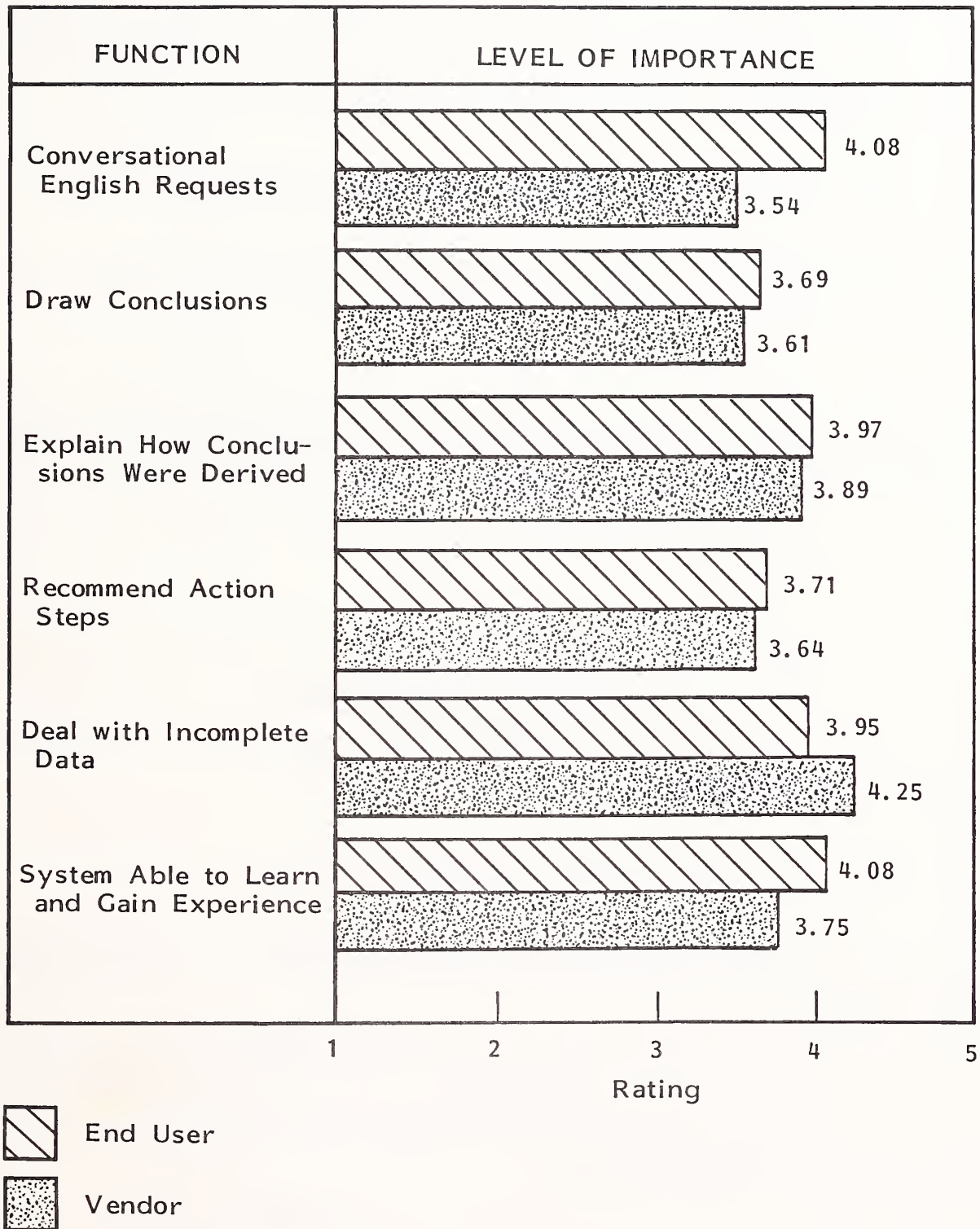
- Vendors have diverse views on the concepts of artificial intelligence and expert systems. As is true with end users, vendor definitions of artificial intelligence cover everything from philosophical discussions to definitions centered around science fiction-like systems.
- Nearly 88% of the vendors agree with INPUT's definition of an expert system (a computer system that simulates human experts in narrowly defined problem areas).
- The vendors generally rate all of the following as important capabilities of expert systems:
  - Deal with incomplete input data;



- Explain how conclusions were reached;
  - Learn and gain experience;
  - Recommend action steps;
  - Draw conclusions;
  - Receive input requests in conversational English.
- The above list is ranked from most important to least important features of an expert system, from a vendors' perspective.
    - It is apparent that vendors expect expert systems to be less user friendly than the more traditional DSS since they do not feel it is important to communicate with an expert system in conversational English. End users, in sharp contrast, perceive that conversational English ability is of paramount importance. See Exhibit IV-6 for a full comparison of expert system functions from both user and vendor perspectives.
    - Vendors cited the most important feature as the system's ability to deal with incomplete data.
    - While expert systems have this capability, it would seem that the more likely prime function would be the ability to draw conclusions. However, this function was rated lower than the others by the users.
    - The vendors feel that ease-of-use, accessibility and voice recognition are desirable traits of expert systems.
  - Use of expert systems and other AI products will not boom until the "expertness" of such systems can be readily demonstrated by establishing such a level of confidence.

# EXHIBIT IV-6

## EXPERT-SYSTEM FUNCTIONS - END USER/VENDOR CONTRASTS



- Data accuracy is just one of the concerns expressed by the vendors with regard to expert systems. This concern surfaced when vendors were asked if they agreed that expert systems would be an integral part of the decision-making process in companies within 3 to 5 years. On a scale of 1 representing total disagreement and 5 representing total agreement, the weighted vendor response was 1.7--indicating a high level of skepticism.
- Various reasons were cited for this skepticism, including:
  - A realistic view that the three- to five-year timeframe is just too short.
  - Comments that it will take more than the given timeframe to modify the management style of decision makers to a point where they would actually rely on a computer system to point to a decision. Significant high-level business is still conducted on the back of envelopes and by intuition.
  - Management suspicion of computers, although the personal computer has helped to alleviate this fear. Relying on computers to actually make decisions will require much more than mere knowledge of PC operations.
  - The accuracy level of such systems.
  - Cultural acceptance of machine intelligence and decision making.
  - A belief that there are not enough experts who can translate their expertise into knowledge bases. This shortage of experts will delay the implementation of expert systems over a broad range of applications for at least 10 years.

- The nearly universal belief that expert systems will still only be usable in very limited, narrowly defined areas.
- Finally, that there are severe technological constraints to such advances, including hardware capacities and processing speeds.
- Vendors believe that expert systems and expert-system generators will be developed.
  - Nine of the 51 vendors said that their company is, or will be, developing expert systems or investigating the possibility of doing so. Two other vendors mentioned that they already have expert-system products.
  - Most of the vendors believe that other companies would be developing ES products. The most frequent responses as to who these vendors might be included:
    - . IBM.
    - . Digital Equipment Corporation.
    - . Xerox.
    - . Apple.
    - . Artificial Intelligence Corporation.
    - . Ashton-Tate.
    - . Lotus.
    - . Microsoft.
    - . "The Japanese."

- Vendors also believe that a number of the larger user companies will be developing expert systems, particularly in narrowly-defined applications areas.
- Finally, nearly all of the vendors who understand the differentiation between expert systems and expert-system generators feel that additional types of expert-systems development tools will be developed.
- Part of the problem with the entire expert-system area is that vendors do not have a firm grasp of the potential price range for ES products or the extent of the potential buyer base.
  - The vendor interviews revealed as many of the vendors thinking of expert systems in the \$1,000-\$2,000 price range as in the category of \$150,000 and above.
  - There is also a significant variation in actual product capabilities. While the full-blown version of EXPERT-EASE lists for \$2,000, a scaled-down version has recently been offered for \$125.
  - Vendor perceptions of hardware required, and the cost of such hardware also shows wide variation, again a sign of the difficulty in determining the applicability for relatively new technology.
- All the vendors believe that expert systems will supplement rather than replace decision support systems. The most prevalent opinions are that DSS and ES are really addressing two distinct issues. Decision support systems and tools have wide, generalized potential use, whereas expert systems address more narrow, highly specialized areas.



## B. THE COMPETITIVE DSS PRODUCT ENVIRONMENT

- As can be seen from the various exhibits reflecting DSS products included throughout this report, the numbers of decision support systems, tools, hardware, and applications are increasing dramatically.
- A crowded environment is most evident in the cross-industry software package area, where many DSS packages are available that perform similar functions in similar environments.
- Recent studies have indicated that there are currently more than 3000 "companies" selling personal computer software products.
  - Many of these companies are single-product companies who hope to be able to rival the success of such early pioneers as VisiCorp.
  - Buyers must be aware that they may be purchasing products from vendors who may not ultimately be able to provide the service and support that they require.
- It is evident that a shakeout has begun to occur in the entire data processing industry. This includes not only vendors of DSS products, but also those who market software products, hardware, and related items such as IS service firms and publishers of industry-specific periodicals.
- Many changes are beginning to appear in the software market.
  - Companies such as Softsmith Corporation and Services Software Inc. have recently filed for protection under Chapter 11.
  - Sorcim Corporation, one of the vendors in this study, was acquired along with Information Unlimited Software, Inc. by Computer Associates International.

- Even VisiCorp, one of the pioneers of the PC software market and instrumental in the DSS explosion, recently merged with Palladin Software.
- The trend toward buyouts, takeovers and mergers is particularly evident in the personal computer software market.
  - With so many vendors focusing on such a seemingly lucrative market, and with so many nearly identical products, a shakeout is a natural consequence.
  - There are now more than twenty thousand systems/programs available for use on personal computers. With the vast variety of PCs available, and with the major manufacturers, including IBM, beginning to take a strong interest in the market, it is likely that the number of available PCs will also drop. Correspondingly, software companies that have focused on certain hardware will also have to redirect their efforts to survive and IS managers must be aware of who supplies their software.
- The more successful vendors are attempting to differentiate their products in a variety of ways. These include:
  - Price.
  - Integration of functions.
  - Vertical market focus.
  - Joint marketing ventures.
- The current main DSS software packages include a number of the following functions:

- Spreadsheet.
  - Modeling language.
  - Data base management.
  - Inquiry facilities.
  - Graphics.
- The vendors see their competition as changing over the next two to three years. Although the vendors see Comshare and LOTUS retaining strong positions, many vendors believe that one of their main competitors would be IBM, who recently entered the PC software market with products that would most likely compete with Lotus 1-2-3 and dBase III.
  - The cost factor is one of the main reasons for the shift in competition. Successful one-product companies that have invested heavily in additional products are beginning to face the same types of problems that swamped and crippled the home computer market. The perception, therefore, is that the competition will come from those companies having the greatest financial resources.
  - The artificial intelligence market is too new to adequately assess competition in two to three years, but it will be a wide open market for vendors with good, user friendly products.
  - The respondents to this study are currently using a wide range of products that they classify as decision support systems. The significant number of products available makes it difficult to determine industry leaders, but Exhibit IV-7 through IV-9 give a representative ranking of products from an end-user perspective by mode of delivery. As can be seen from these exhibits,

## EXHIBIT IV-7

### TOP PERSONAL COMPUTER SOFTWARE PRODUCTS

- Lotus 1-2-3 (Lotus Development Corporation)
- dBase II (Ashton-Tate)
- VisiCalc (VisiCorp)
- IFPS Personal (Execucom)

## EXHIBIT IV-8

### TOP MAINFRAME/MINICOMPUTER DSS SOFTWARE PRODUCTS

- IFPS (Execucom)
- FOCUS (Information Builders)
- SAS (SAS Institute)



## EXHIBIT IV-9

### TOP DSS REMOTE COMPUTING SERVICE VENDORS

- Data Resources Inc.
- Chase Decision Systems
- Dun & Bradstreet

the current market for DSS products and services consists mainly of spreadsheets, modeling languages and data base management systems.

- Spreadsheets and modeling languages will continue to play an important role as DSS software, but additional capabilities must be included for these products to remain viable. These capabilities include:
  - Fourth generation languages for prototyping and creating user-friendly data retrieval systems.
  - Graphics for analysis, reports and presentations.
  - Data base management systems for information storage and retrieval.



## V USER EXPENDITURE FORECASTS





## V USER EXPENDITURE FORECASTS

### A. OVERALL EXPENDITURES

- Total user expenditures for DSS products and services will be \$2.928 billion in 1984 and are expected to reach \$10.615 billion by 1989. This represents an average annual increase in user spending for DSS related products and services of approximately 29%, compared to an overall industry rate of 22%, indicating that a large proportionate share of IS budgets is being spent for decision support.
- Expenditures for DSS products and services will be increasing at a growth rate that exceeds the overall growth rate of the information services industry in every segment that offers DSS products, except processing services, as shown in Exhibit V-1.
- One reason for this is reflected in Exhibit V-2, which shows a large percentage of the respondents for this study anticipating some activities connected with DSS acquisition in the near future.
  - The highest percent of users indicate that they will acquire or build a DSS product/service in the next two to three years.
  - A number of these users indicate that they will build rather than purchase a DSS, although such actions could be costly.

EXHIBIT V-1

DECISION SUPPORT SYSTEMS EXPENDITURE FORECAST  
BY MODE OF DELIVERY

MODE OF DELIVERY	DECISION SUPPORT SYSTEMS EXPENDITURES		
	1984 (\$ Millions)	1989 (\$ Millions)	AAGR 1984-1989 (Percent)
Processing Services			
Remote Computing	\$1,250	\$2,260	13%
Utility Processing	60	150	19
Subtotal	\$1,310	\$2,410	13%
Software			
Mainframe/Mini	\$ 490	\$2,180	35%
Microcomputer	650	3,480	40
Subtotal	\$1,140	\$5,660	38%
Professional Services			
Software Development	\$ 180	\$ 930	39
Consulting	60	280	36
Education	20	240	63
Subtotal	\$ 260	\$1,450	41%
Turnkey Systems	\$ 220	\$1,100	38%
Total	\$2,930	\$10,620	29%

# EXHIBIT V-2

## FUTURE DSS ACTIVITIES

INDUSTRY	PERCENT OF USERS				
	Do Nothing	Study	Probably Build/ Acquire	Acquisition in Progress	Have/ Expand
Banking and Finance	10%	19%	26%	35%	10%
Distribution	20	25	30	20	5
Insurance	-	30	20	30	20
Manufacturing	9	22	30	21	18
Service and Other	20	35	20	20	5
Transportation and Utility	-	32	36	20	12
Overall	9	25	29	23	14

- Nearly one-quarter of the companies interviewed are in the process of acquiring a DSS product.
- Responses from both IS and end-user personnel indicate the same general trends.
- From a software perspective, this survey indicates that future activities connected with decision support will be centered around personal computers that will be increasingly linked to mainframes. IS personnel generally choose mainframe DSS over personal computer DSS, while end users reverse this ranking. This corresponds to the general trends and characteristics of companies progressing through the three maturity stages and moving from planning and analysis users to operational production system users.
- Expenditures for microcomputer software will increase faster than expenditures for mainframe and minicomputers as an increasingly large number of companies begin exploring the capabilities of automated decision support.
- Turnkey systems for DSS will focus on vertical industry applications in many areas including:
  - . Cash management.
  - . Manufacturing master scheduling.
  - . Medical diagnostic tools.
- Professional services firms will be receiving increasing user expenditures due to the lack of qualified personnel with knowledge in advanced decision-making applications. Until DSS applications become so simple and user friendly that even a complete novice could develop one, decision support builders and users will continually require education.

- Expenditures for RCS, including those for utility processing, will be steadily decreasing as companies increasingly turn more toward a linked micro-to-mainframe environment.
- RCS vendors' roles will change from merely providing DSS tools, to providing DSS applications custom tailored to a specific user's environment. RCS vendors can provide the network for linking user's corporate data bases with other in-house and remote data bases, and can provide processing, storage and network support.

## **B. INDUSTRY-SPECIFIC APPLICATIONS**

- DSS products and services in all industry sections will experience significant growth according to this study. There are some variations that can be attributed to the characteristics of companies within various industries. The following sections describe some of the variables in each of these sectors.

### **I. BANKING AND FINANCE**

- Banking and finance firms were among the earliest users of rudimentary decision support systems. Financial planning and performance tools, including spreadsheets, naturally found easy entrance into the financial community.
- Other DSS application areas in this sector include the following:
  - Credit analysis.
  - Interest rate modifications.
  - Tax analysis.



- Portfolio analysis.
- Branch performance.
- Less industry-specific DSS software is anticipated to be developed for this sector since many of the potential applications areas are financial in nature and are being adequately addressed by cross-industry application software.
  - Potential areas for industry-specific DSS applications include the retail banking and commercial credit/loan functions. For example, a customer financial goal analysis and product choice expert system may assist in attracting additional customers and increased revenues from providing new/additional services to customers.
  - Another potential DSS application area would be automatic or semi-automatic credit authorization.
- RCS expenditures in the banking and finance sector will continue to grow because:
  - This sector makes considerable use of on-line data base services, provided by RCS firms in conjunction with DSS applications.
  - The banking industry will continue to rely on RCS networks for distributed DSS.
- The larger banking- and finance-sector companies are not as mature as companies in other sectors. There are two diametrically opposed reasons for this:
  - Many firms in this sector have highly centralized IS functions, with such strong overall control that there is little apparent end-user

computing. Thus, initial stage DSS "spurs" may not yet have developed in such organizations.

- Other firms in this sector have distributed their IS activities to many functional areas, covering those areas with most pressing IS needs, yet remote enough from a centralized function not to require strategic decision-making support.

## 2. DISTRIBUTION

- Decision support systems have had a profound impact on the distribution industry sector. Market planning, pricing, "what if" exercises, and sales analysis are applications currently experiencing widespread use in the distribution sector. Another significant use of decision support systems in the distribution sector involves transportation and transportation-related services, topics that will be elaborated upon in the transportation and utilities segment following.
- Turnkey DSS will remain a constant presence in the distribution industry sector since this sector has not experienced the significant development of industry-specific DSS or non-DSS application software as have other sectors. In fact, many of the companies in the sector are still implementing major baseline applications--making them, in effect, Stage I users.
- RCS expenditures within the distribution sector will reflect the smallest increase in any DSS category in any industry sector. RCS vendors have, to a large extent, ignored this industry-specific sector, making it increasingly difficult for RCS vendors to provide unique, value-added, DSS products/services for this industry sector, due to the prevailing trend toward in-house DSS operations.

### 3. INSURANCE

- The insurance industry closely parallels the banking and finance industry sector. Each will significantly reduce utilization of RCS vendors' products and correspondingly increase use of personal computer software. Both of these industry sectors have had significant support from software application package vendors, resulting in large expenditures for software purchases.
- Correspondingly, these industries have typically had large centralized data processing organizations and data centers. This has led to a reduced utilization of remote computing services. In fact, a significant number of companies within this industry sector have attempted (or are attempting) to establish RCS capabilities as a part of their overall holding company structure.
- Use of DSS in the insurance sector will focus on supporting the rate setting and risk selection processes to improve marketing and underwriting.
- DSS users in the insurance industry will require:
  - Improved marketing intelligence.
  - Faster agent communications.
  - Analytical tools to support underwriting and actuarial methods.
  - Tie-ins with normal production systems used for processing policies and claims.
  - More sophisticated agent support systems.

#### 4. MANUFACTURING

- Some sophisticated data processing systems are currently being developed for the manufacturing industry sector. Computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-aided engineering (CAE) along with robotics and MRP II can all be thought of as comprising a part of DSS within the manufacturing sector.
- Manufacturing resource planning (MRP II) systems offer a decision support mechanism that can transcend traditional transaction processing and historical manufacturing management information systems. MRP II systems are being used for:
  - Simulating the business operations.
  - Production job scheduling.
  - Proper inventory planning and economic reordering.
- However, present MRP systems are not truly used as decision support systems due to their complexity, their requirement for extensive user education and the perception that they are useful only for material requirements planning. Furthermore, in many instances, these systems do not use an integrated corporate data base.
- Future MRP II systems, in order to be classified as true decision support systems, must:
  - Be based on DBMS software.
  - Be interactive.

- Have sophisticated techniques for modeling all of the manufacturing process relationships, including:
  - . Parts.
  - . Supplies.
  - . Inventory.
  - . Machines.
  - . Tooling.
- Be fully integrated backwards into raw materials inventory, receiving, purchasing, and accounts payable.
- Be fully integrated forward into finished goods inventory, shipping, accounts receivable, sales tracking, and forecasting.

## 5. SERVICE AND OTHER

- The "Service and Other" industry sector represents an extremely diverse category of businesses. Research during this study revealed both large-scale DSS users and firms with minimal baseline application support.
- The types of businesses included in this sector range from lawyers and accountants to construction, real estate, motels, and museums.
- From an overall perspective, these industries are characterized by a large number of small firms and a few very large firms, principally in the engineering services and accounting areas.



- The diversity of this sector is so great that it is entirely plausible that a one- or two-person business may have or utilize a DSS product or service, while the larger firms may have no automated support other than a payroll system.
- However, the diversity is such that it will allow the development of tools for very specific industries within this overall sector.
  - For example, hotels and motels could utilize capacity and room availability planning models to better address the needs of their users.
  - Research firms could use DSS products to organize and tabulate their research findings, thus being able to "fine-tune" those findings more accurately.
  - Accounting and auditing firms would often use current DSS products and services since these products and services are very financially oriented.
- RCS expenditures will also remain large for this industry sector, rising from its diversity and the current lack of sophisticated DSS product and service support capabilities.

## 6. TRANSPORTATION AND UTILITIES

- Areas of potential for DSS systems in the transportation industry include:
  - Vehicle repair frequency evaluation.
  - Vehicle operation costs and analysis.
  - Repair interval monitoring and notification.
  - Logistics modeling.
  - Tariff filing system.

- Primary DSS applications for utilities are in:
  - Rate cost analysis.
  - Local management.
  - Gas-dispatching models.

### C. CROSS-INDUSTRY APPLICATIONS

- Cross-industry applications currently account for approximately 33% of all information services expenditures, regardless of delivery vehicle or mode. However, this percent will drop by 1989, as more and more DSS are developed for specific vertical applications.
- Of the current cross-industry classifications, planning and analysis applications receive the greatest level of user expenditures. This is an outgrowth of the current prevalent heavy use of decision support systems in the financial planning and analysis areas.
  - Growth in the planning and analysis cross-industry segment has been propelled by micro-based spreadsheet and integrated analysis systems. Such systems will continue to be used for such applications in nonfinancial functions.
- A significant cross-industry application area just beginning to emerge is in engineering and scientific applications. These applications, which include computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-aided engineering (CAE) systems, will find increasing use in a variety of industries.

- In environments with relatively little in the way of sophisticated data processing systems, such as in smaller manufacturing concerns, engineers--schooled in and on computers--are demanding and receiving more computerized support.
- RCS has been and continues to be a large receiver of user expenditures on applications that are often computer intensive and involve use of vector and array processors. Specialized software resident on RCS firms' computers also contribute to large user expenditures. Such software includes applications for:
  - . Structural analysis.
  - . Piping analysis.
  - . Electronic circuitry.
  - . Geometric modeling.
- Mini-based turnkey systems or workstations can provide the smaller scientific or engineering professional with better tools than are currently used.
- Another sector of cross-industry applications where DSS growth is surpassing overall industry growth is in the area of on-line data bases.
  - This is partially attributable to the proliferation of micro and personal computers that has dramatically increased the potential user base.
  - On-line data bases will provide many corporate offices with a means to access macro-level data, typically financial, for relatively minimal expense.

- The slowest growing cross-industry DSS segment over the next five years will be human resources. This segment includes personnel and payroll systems as well as some of the more DSS-oriented human resource functions, including EOE planning.

## **VI TECHNOLOGY AND INFLUENCING FACTORS**





## VI TECHNOLOGY AND INFLUENCING FACTORS

- There are many factors influencing the growing use of decision support systems and the changing nature of DSS products and services.
- One of the most significant factors will center around technological progress toward an era of artificial intelligence. Products that INPUT classifies under the artificial intelligence umbrella include:
  - Natural language query systems.
  - Expert and/or knowledge-based systems.
  - Robotics.
  - Vision systems.
  - Voice recognition/synthesis products.
  - Expert-system generators.
  - Specialized languages (LISP, PROLOG).
  - Fifth generation computing.
  - Artificial intelligence machines.

- Much research is being conducted in companies and universities in these and other related areas. The total practical application of DSS within companies is truly dependent on technological achievements.
- Technology and its geometric advances tends to outstrip attempts to utilize and profit fully from new inventions, ideas and capabilities.
- When over 250 vendors displayed their robotics products at a trade show in 1983, only one manufacturer made money.
  - The problem with certain technological products may be that they are not cost effective and are not highly desired during the early stages of development except as "glamour" products for high visibility showcase companies.
  - In such companies, company executives may want leading-edge items, which may pressure the IS executive into adapting products in a useful manner.
- With other products such as natural language query systems (NLQS), a different set of technology-related issues appear. NLQS currently utilize two main techniques to analyze a request:
  - The first method involves parsing a sentence (determining its grammatical parts), then analyzing the meaning or syntax of the sentence and attempting to understand its semantics. This approach is the more common for NLQS, but the method also requires significant computer-processing power.
  - The second method involves building into the system some knowledge of a particular subject area. This unfortunately severely restricts the system's potential use, but could be an easier means of implementing NLQS in some companies.

- The technological challenge with natural language query systems will be for the vendor to reduce the processing power required for such systems without limiting the scope of the system's potential application. This will involve the vendor's constant monitoring of hardware developments in order to be able to adapt NLQS to advanced hardware as rapidly as possible.
- Work on "parallel processors", particularly the multiple instruction-multiple data (MIMD) type, may or may not resolve the hardware problem. Research in these and associated areas may point to alternative solutions. Alternative strategies, research, and technological developments may also prove beneficial. Until the last few months there were only three vendors of LISP (or PROLOG)-type machines, whereas now more hardware vendors are exploring the possibilities of LISP-type processors as being a key to successfully developing artificial intelligence capabilities.
- Most aspects of critical technology associated with advanced decision support systems (including artificial intelligence) are progressing slowly and will tend to limit the overall potential for DSS applications.
- Other factors will make the DSS marketplace very dynamic and volatile over the next few years.
  - Primary among these is the fact that a new cycle to refresh mainframe software will begin in the mid-1987 timeframe. Given the rapid technological changes that have been occurring with regard to decision support products and services, it is possible that highly advanced products may be available then that could completely alter potential DSS uses and users.
  - Such changes may involve significant developments in artificial intelligence and related products and facilities.

- These changes may also involve significant alterations in current product pricings. As the forces of the market begin to sift out the more marginal vendors, those remaining may find themselves in a highly strengthened position, thus allowing them better control of the overall market.
- Pricing changes may also result from rising costs in developing increasingly sophisticated software, most likely combining advanced micro-to-mainframe capabilities.
- The life expectancy for microcomputer software is currently even shorter than that for mainframe products, averaging between 24 and 30 months. As such, the point where the cycle begins to refresh is in mid-1986. The impact of this is significant since many more companies will be at Stage II DSS maturity and will be looking toward more integrated, micro-mainframe-linked DSS software.
- Another factor that has to be singled out as a prime factor is the emergence of end-user computing, which encompasses many of the other factors. For most of the history of electronic data processing, control of data processing has remained in the hands of trained professionals and technicians.
  - The advent of home computer games signaled the beginning of an era where an increasing number of lay people began to have everyday interaction with computers in one form or another.
  - The decreasing costs for hardware also were a hallmark in the trend away from large, centralized systems. These were made possible by advancements in chip technology which made the development of powerful mini and microcomputers possible.
- The advent of these smaller, powerful computers led more and more companies to install such systems in a decentralized manner as a means to



enhance productivity and reduce the growing backlog of systems awaiting development or modification by traditional data processing organizations. The growing use of these microcomputers increased user desire for more and increasingly sophisticated applications. This in turn is increasing IS backlogs, even in an era of end-user computing.

- The availability of a system/capability such as VisiCalc ushered in the era of widespread use of decision support tools. As we now approach the potential for computerized decision making, the psychological aspects of human behavior will strongly influence and retard computerized decision making except in limited areas.
- The technology factors and implications of decision support systems are:
  - Highly significant.
  - Highly dramatic.
  - Highly visible.
- Users and vendors can expect to spend significant dollars if they wish to be at the leading edge in the development and/or use of high technology products. The potential paybacks for such systems can be highly rewarding.
- Technology continues to provide significantly better decision-making aids and higher quality products. Although great strides in advanced technology are expected within the next five years, it will take a much higher level of sophistication and a much longer time for computers to assume the human role as a decision maker.



## VII RECOMMENDATIONS



## VII RECOMMENDATIONS

- These recommendations are divided into three concurrent action plans that may be followed to move the IS organization from its current level of DSS activity to a point of congruence between user requirements and IS or outside vendor offerings.
- These action plans assume that the level of DSS activity in a user organization moves, by design, through the three stages of development defined in this report. The plans themselves attempt to respond to current user requirements for DSS while positioning the user and IS organization for the next stage of development.
- Not all companies, or departments within a company, move through these three stages. It may be entirely appropriate for a company or department to remain at a particular stage when the DSS developments and applications are cost effective and provide useful solutions.
- The three action plans are:
  - Create an environment in which DSS may grow.
  - Monitor the growth of DSS in the industry.
  - Buy or build systems that provide decision support.



## A. CREATE A DYNAMIC DSS ENVIRONMENT

- Decision support systems, as discussed earlier, are multifaceted and very dynamic. User requirements tend to grow rapidly and change quickly. To support such dynamism without a proper environment invites stagnation at a premature stage or places an overwhelming demand on the IS organization. What is needed is an environment that accommodates, or even invites, change. Several action items that represent steps to this environment are discussed below.
- Determine short- and long-term strategic plans appropriate for main overall corporate direction. Strategic planning is, in fact, a key to the development of quality decision support, particularly with companies moving from Stage I to Stage II maturity level. Strategic plans should address the following topics/issues:
  - The functional areas of the organization that should be and will be receiving DSS support.
  - The timeframes for implementation of decision support systems.
  - Mainline corporate strategic issues prioritized in terms of applicability to automated decision support.
  - The overall requirements in terms of IS and end-user personnel, hardware, software, and available and necessary data.
  - The inter- and intra-decision support system dependencies, that help identify a critical path implementation schedule.
  - The organization that will retain primary responsibility for developments in end-user computing. A clear distinction is necessary among

roles of the IS organizations, the end users, and the information center--if such an organization exists.

- The IS manager must also become a provider or coordinator of user training by:
  - Helping individuals become computer literate.
  - Helping functional departments understand the capabilities and limitations of DSS and their potential as solutions to management decision problems.
  - Explaining to users the potential directions for DSS and what these may mean to the end user.
- IS must also identify potential application areas at the standalone, end user, and corporate levels.
- A very important and indeed crucial IS role will be to assist users in hardware/software purchasing decisions so that the purchases support the overall DSS strategy. In terms of decision support, systems will be developed that have both a short-term and more global impact. The shorter-term applications can typically be developed in a standalone mode by end users while the more global systems will typically be developed in a more formal application development mode.
- A very significant role for IS will be to provide for the use, maintenance, and security of corporate data. This will entail:
  - Determining which users will have access to what corporate data.
  - Developing strategies and facilities for access to, and security of, this data.

- Clarification of roles is particularly important since there are strong rivalries among IS, end user, and information center personnel, even though there will probably be more DSS-related work available than any individual group can handle. This clarification should resolve questions concerning:
  - What each party can expect of the others.
  - The level of coordination necessary between the parties in order to achieve maximum effectiveness.
  - The person responsible for each coordinated effort.

## **B. MONITOR INTERNAL AND EXTERNAL DSS DEVELOPMENT**

- The development of DSS support as an application within the organization and as a product opportunity for vendors suggests that:
  - As users discover the uses of DSS, user demands and requirements for more DSS support will increase. Requests for tools, data, and more overall capability will increase.
  - Vendors also will be developing and making available more useful and sophisticated products.
- In order to anticipate future user requirements and vendor capabilities, IS must keep in constant contact with both groups.
  - IS must monitor the growing list of requests being made of IS--the tools in use, and the data requirements--to determine the change in level of DSS activity.

- As application packages become available from an increasing number of vendors, IS must understand what these applications are, what they require from a technical point of view, and what directions vendors are taking in the marketplace.
- IS must also closely monitor technological developments since these can have a dramatic impact on use of decision support and decision-making applications. This will entail reviewing both hardware and software developments for both decision support and artificial intelligence applications.
- IS should also be in a mode to facilitate inter- and intra-departmental links, particularly in conjunction with end-user computing activities. This is especially a crucial task in organizations in a decentralized or distributed mode.
- Also, and particularly in decentralized organizations, IS should be available to serve as a technical interface for dealing with vendors. Such a role could be beneficial in:
  - . Coordinating the acquisition of personal computers;
  - . Providing technical evaluations of similar software packages;
  - . Arranging for volume purchase arrangements;
  - . Ensuring the proper levels of vendor support for maintenance, new version releases, etc.
- As data bases used for DSS turn into "knowledge bases," industry-specific knowledge and application tools will be increasingly sought. These developments will be key benefits that signal the availability of truly integrated decision making systems.

### C. BUY OR BUILD SYSTEMS THAT PROVIDE DECISION SUPPORT

- In the near future it is unlikely that DSS product vendors will shift their focus from specific products to solutions. DSS tools will not have the proper interfaces to the general user, functional user, IS user, information center user, or product operational/production user. IS will need to take the lead in acquiring the right DSS tools and building the appropriate interfaces for the various users.
- These interfaces or linkages among DSS tools, data, and users must be such that:
  - The system is transparent to the user.
  - Requests from the user are easy to articulate.
  - The process of developing a solution to a problem is straightforward and relatively free of direct IS staff support or intervention.
- IS may also be called upon to establish an information center, although the end user may initiate such a facility.
  - In establishing such a facility, IS should ensure the availability of the appropriate tools (software and hardware) that the user may require.
  - One possible way to accomplish this may be to sample packages available through RCS vendor facilities.
  - IS should also provide appropriate training for end users.
- As a part of the natural process of maturing through the three stages of DSS development, increasing integration of and interfacing among products will be



required. A natural role for IS will be to provide the facilities to allow such interfacing and integration, through a "universal gateway" facility if appropriate in the user's company.

- IS must also position itself to avoid becoming a bottleneck of DSS developments. In line with this, IS must learn to avail itself of whatever resources are available, including those of vendors, outside consultants, and end users.
- Finally a major responsibility of IS will be as the provider of corporate data for decision making and decision support.
  - This responsibility will reside with IS regardless of the degree of end-user computing sophistication, since IS will remain the central repository of data from normal production systems.
  - Providing for the integrity of this data, and its correct application in decision support is a key IS role, and will remain so regardless of technological sophistication and developments in artificial intelligence.



## **APPENDIX A: DEFINITION OF TERMS**



## APPENDIX A: DEFINITIONS OF TERMS

- ARTIFICIAL INTELLIGENCE - Multidisciplinary attempts to simulate intellectual activity using computers. Still in its infancy, AI includes the use of robots, expert- and knowledge-based systems, natural language query systems, expert-system generators, and the like.
- DATA BASE MANAGEMENT SYSTEM - A generalized computer program that handles the mechanics of storing, updating, and accessing data for multiple applications. This definition does not include file management systems that are designed primarily for single applications.
- DECISION SUPPORT SYSTEMS - Computer-based programs used for the collection, synthesis, analysis and reporting of information in such a way that more informed decisions are rendered by the decision maker more efficiently. The system is usually comprised of an inquiry or language facility, a knowledge or data base, and a problem processor.
- EXPERT SYSTEMS - Computer-based programs that make original judgments based on general facts about a situation, typically requiring intensive interactions with an expert knowledgeable in a given field. Can handle problems with no algorithmic solution.
- EXPERT-SYSTEM GENERATORS - LISP or PROLOG language programmer productivity tools that include data/knowledge base management capabilities, a logic interpretation module (inference engine), and frequently, window management capabilities.



- FINANCIAL MANAGEMENT AND PLANNING SYSTEM - Software package used to model all or part of a company's financial planning. This system is used to create end-user solutions to financial planning problems, either directly or through the generation of end-user computer programs that, in turn, are executed to forecast the desired financial or planning data.
- FOURTH-GENERATION LANGUAGE (FGL) - A software tool, used for coding computer instructions, that is nonprocedural (i.e., focuses on the result, rather than the process of obtaining the result). Unlike its closest programming language predecessor, COBOL, FGL is Englishlike, nontechnical, flexible, easy to start to use, and numerous in its built-in functions.
- GOAL SEEKING - Ability to set a specific target or goal and view the net effect on other equation variables.
- HEURISTICS - Collection of intuitive rules; experiential reasoning.
- KNOWLEDGE-BASED SYSTEM - See Expert System.
- LISP - A computer language associated with artificial intelligence, denoting List Processing. LISP uses symbolics instead of alpha/numeric characters. Previously this term was fully associated with a type of computer hardware, but LISP compilers are now available for standard computers as well.
- NATURAL LANGUAGE QUERY SYSTEMS - Possess abilities to understand conversational English, respond to similar questions worded in a variety of ways, resolve request ambiguities, function without regard to data structure formats.
- PROLOG - A computer language similar in function to LISP. Name stands for Programming in Logic.

- ROBOTICS - The application of computers to perform tasks normally performed by a human, through use of anthropomorphic devices (arms, hands, etc.).
- VISION SYSTEMS - Computer delineation of objects based on sensory image recognition.
- VOICE RECOGNITION/SYNTHESIS - Computer understanding of human speech and the ability to respond through a voice mechanism.
- WHAT-IF ANALYSIS - Provides users with the ability to see what effect changing one variable will have on others.



## **APPENDIX B: DSS VENDOR QUESTIONNAIRE**





## DSS VENDOR QUESTIONNAIRE

INPUT, a research and consulting firm, is conducting a study of the present state and future direction of Decision Support Systems. We want your organization to be represented in this study by describing what DSS products you are now marketing, new product plans you have, and what problems you see in this marketplace.

In return for your participation in this study, we will send you a summary of this study at its completion.

None of the information that you provide will be associated with your company, unless you wish otherwise.

Please tell me your TITLE

1. What are your perceptions of what a Decision Support System is or should be?

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2. What Decision Support System products/services do you currently offer?

PRODUCT NAME	TYPE*	WHAT HARDWARE IS IT COMPATIBLE WITH?	WHAT OPERATING SYSTEM IS IT COMPATIBLE WITH?	NUMBER OF INSTALLATIONS US	WW
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A.

B.

C.

D.

E.

\*TYPE

MAINFRAME SOFTWARE PRODUCT (MF)  
MINICOMPUTER SOFTWARE PRODUCT (MN)  
PERSONAL COMPUTER SOFTWARE PRODUCT (PC)  
RCS  
TURNKEY SYSTEM (TS)

3A. What are the charges for: (Refer to products A to E above)

PURCHASE

Product A \_\_\_\_\_  
Product B \_\_\_\_\_  
Product C \_\_\_\_\_  
Product D \_\_\_\_\_  
Product E \_\_\_\_\_

3B. What were your revenues for DSS products/services in 1983? What do you expect your DSS revenues to be in 1988? (If you can't break out details, get total)

	<u>1983</u>	<u>1988</u>
SOFTWARE PRODUCTS - MAINFRAME	_____	_____
SOFTWARE PRODUCTS - MINICOMPUTER	_____	_____
SOFTWARE PRODUCTS - PERSONAL COMPUTER	_____	_____
RCS	_____	_____
PROFESSIONAL SERVICES	_____	_____
TURNKEY SYSTEMS	_____	_____
TOTAL	_____	_____

4. Can you estimate your share of the DSS market? (NO, go to Question 5A) (If you can't break out details, get total)

	<u>1983</u>	<u>1988</u>
SOFTWARE PRODUCTS - MAINFRAME	_____	_____
SOFTWARE PRODUCTS - MINICOMPUTER	_____	_____
SOFTWARE PRODUCTS - PERSONAL COMPUTER	_____	_____
RCS	_____	_____
PROFESSIONAL SERVICES	_____	_____
TURNKEY SYSTEMS	_____	_____
TOTAL	_____	_____

5A. Who are your top three competitors in the DSS marketplace?

VENDOR

PRODUCT

- |    |       |       |
|----|-------|-------|
| 1. | _____ | _____ |
| 2. | _____ | _____ |
| 3. | _____ | _____ |

5B. What are your perceptions of your competitors' strengths and weaknesses in the DSS market? (For each competitor listed above)

STRENGTHS

- |    |       |
|----|-------|
| 1. | _____ |
|    | _____ |
| 2. | _____ |
|    | _____ |
| 3. | _____ |
|    | _____ |

WEAKNESSES

- |    |       |
|----|-------|
| 1. | _____ |
|    | _____ |
| 2. | _____ |
|    | _____ |
| 3. | _____ |
|    | _____ |

5C. Who do you see as being your top three competitors in the DSS marketplace in 2-3 years?

VENDOR

PRODUCT

- |    |       |       |
|----|-------|-------|
| 1. | _____ | _____ |
| 2. | _____ | _____ |
| 3. | _____ | _____ |

5D. What are the reasons for any changes from today?

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5E. In 2 to 3 years, do you believe there will be more or fewer:

VENDORS?	MORE	FEWER
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PRODUCTS?	MORE	FEWER
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5F. What are the reasons for the change?

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5G. What are the key issues your company needs to address in the DSS marketplace?

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6. Do you target specific industry market sectors?

( ) YES

( ) NO (Go to Question 7)

Which market sectors and what size companies in those sectors do you target?

BANKING AND FINANCE:	ASSETS	_____
SERVICES:	REVENUE	_____
INSURANCE:	SALES	_____
MANUFACTURING:	SALES	_____
TRANSPORTATION:	SALES	_____
UTILITIES:	SALES	_____
DISTRIBUTION:	SALES	_____
OTHER (PLEASE SPECIFY)	SALES	_____

7A. Do you target specific cross-industry applications?

<u>APPLICATION</u>	<u>CURRENT</u>	<u>2-3 YEARS</u>
ACCOUNTING	_____	_____
PLANNING & ANALYSIS	_____	_____
HUMAN RESOURCES	_____	_____
SALES, MARKETING, DISTRIBUTION	_____	_____
ENGINEERING & SCIENTIFIC	_____	_____
ADMINISTRATIVE	_____	_____
OTHER (PLEASE SPECIFY)	_____	_____

7B. What are the key reasons these applications are targeted?

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8. Do you target specific users in each sector (e.g., corporate planners, treasurers, marketing directors, etc.)?

( ) YES ( ) NO (Go to Question 10)

9. Which ones and why?

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10. What are the main reasons users buy your DSS product/services?

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11. Of the following functions, please rank the top 5 in terms of its importance to a Decision Support System, both currently and in 2-3 years.

	<u>CURRENT</u>	<u>2-3 YEARS</u>
DATA ACQUISITION (E.G., FROM CORPORATE MAINFRAME, EXTERNAL DATA BASES, ETC.)	<hr/>	<hr/>
DATA BASE MANAGEMENT	<hr/>	<hr/>
SPREADSHEET	<hr/>	<hr/>
SELF DOCUMENTING MODELING LANGUAGE	<hr/>	<hr/>
FORECASTING CAPABILITY	<hr/>	<hr/>
FINANCIAL FUNCTIONS	<hr/>	<hr/>
STATISTICAL FUNCTIONS	<hr/>	<hr/>
WORD PROCESSING	<hr/>	<hr/>

REPORT GENERATION	_____	_____
GRAPHICS CAPABILITY	_____	_____
TELECOMMUNICATIONS	_____	_____
PROTOTYPING CAPABILITY	_____	_____
FINANCIAL CONSOLIDATION	_____	_____
TRANSACTION PROCESSING	_____	_____
OPERATIONS RESEARCH FUNCTIONS	_____	_____
NETWORKING	_____	_____
ERGONOMIC FEATURES (MOUSE, ICONS, TOUCH SCREEN, WINDOWS)	_____	_____

12A. What requirements will the continued use of the Information Center place on your DSS product/service?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

12B. What plans do you have to make sure your products meet these requirements?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

12C. What requirements will micro-to-mainframe hookups place on your DSS products/services?

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12D. What plans do you have to make sure your products meet these requirements?

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13A. With 1 being low importance and 5 being high importance, how important is it for your DSS product/service to be compatible with other vendors' DSS products/services?

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13B. Why?

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13C. (If response to 13A is 3, 4 or 5) please tell me:

<u>YOUR PRODUCT</u>		<u>COMPATIBLE WITH</u>		
<u>NAME</u>	<u>MF/MINI/PC</u>	<u>VENDOR</u>	<u>PRODUCT</u>	<u>MF/MINI/PC</u>

13D. How will these products be compatible?

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14A. With 1 being low importance and 5 being high importance, how important is it for your DSS product/service to access external data bases?

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14B. Why?

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14C. If response to 14A is 3, 4, or 5, please describe these external data bases?

<u>NAME</u>	<u>TYPE</u>	<u>VENDOR</u>	<u>CURRENT/IN 2-3 YEARS</u>
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15A. With 1 being low importance and 5 being high importance, how important is it for you to offer professional consulting services in conjunction with your DSS product/service?

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15B. Why?

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15C. Please describe the nature of such consulting services?

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16. What are your plans for developing future DSS products/services?

PLEASE DESCRIBE

A. MAINFRAME

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B. MINICOMPUTER

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C.      STANDALONE PERSONAL COMPUTER (E.G., IBM PC OR PC/XT)

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D.      PERSONAL COMPUTER WORKSTATION (E.G., IBM XT/370 OR  
3270-PC)

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E.      RCS SERVICE

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F.      TURNKEY SYSTEMS

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16G. What differences will there be among these products/services? (e.g., functions, applications, price, targeted users, etc.)

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16H. What software operating system will these DSS products operate under?

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16I. What are the reasons for using these particular operating systems?

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17A. The next set of questions relate to so called Expert or Knowledge-Based systems, which are part of the emerging field of artificial intelligence. For purposes of this study, we are defining expert systems to mean the following:

"A computer system which simulates human experts in narrowly defined problem areas." Do you agree with this definition?

(    ) YES                      (    ) NO

17B. If "NO" please tell me how you would modify it?

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18A. With 1 representing low importance and 5 representing high importance, how important to an expert system would you rate the following features:

- Ability of the user to make requests in conversational English;
- Ability of the system to draw conclusions;
- Ability of the system to explain how conclusions were reached;
- Ability of the system to recommend action steps;
- Ability of the system to deal with incomplete input data;
- Ability of the system to learn and gain experience.

18B. What other features do you feel are important to an expert system?

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18C. (For each response of 3, 4 or 5 to Question 18A) why is this feature important?

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19A. With 1 representing disagreement and 5 representing agreement, to what extent do you agree that "within 3 to 5 years expert systems will be an integral part of the decision making process within companies."

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19B. Why?

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(If response to 19A is 1 or 2) Go to Question 20.

19C. In your opinion, what specifically should an expert system do?

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19D. What specific decision making applications do you see as being the most suitable for being developed as an expert system? (get specific examples)

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(If necessary, prompt with following and get specific examples):

PLANNING

MARKETING

PRODUCTION

DATA PROCESSING

OPERATIONS

DISTRIBUTION

INVENTORY CONTROL

ACCOUNTING

FINANCE

HUMAN RESOURCES

LAW

ARCHITECTURE

MEDICINE

SALES

ENGINEERING

RESEARCH & DEVELOPMENT

- 19E. What makes these decision making applications suitable for being developed as expert systems?

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- 19F. Do you expect these expert system applications to be developed:

By yourself? ( ) YES ( ) NO

By other vendors? ( ) YES ( ) NO

Which vendors?

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By user companies? ( ) YES ( ) NO

Which corporate departments?

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19G. Will an expert system development tool be used?

(    ) NO

(    ) YES

Which development tools?

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20A. What are your plans for developing expert systems? Please describe your plans and products.

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20B. What do you expect the price of an expert system to be:

(    ) Less than \$50,000

(    ) \$50,000 to \$100,000

(    ) \$100,000 to \$150,000

(    ) More than \$150,000

20C. What do you expect the cost to be of the hardware needed to run the expert system?

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20D. Please describe this hardware?

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20E. What are your plans for developing expert system development tools? Please describe your plans and products.

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21A. In your opinion, will expert systems supplement Decision Support Systems or will they replace Decision Support Systems?

(    ) SUPPLEMENT                      (    ) REPLACE

21B. Why?

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22. What do you see as being the major obstacles to implementing expert systems?

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23. In 5 years, what do you expect your revenues to be from expert systems?

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24A. We have discussed only one area of artificial intelligence, specifically expert systems. What are your general perceptions of what artificial intelligence is?

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24B. What other areas of artificial intelligence do you feel will gain in importance in the future?

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25. What are your plans for developing products in the artificial intelligence area? Please describe your plans and products.

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**THANK YOU**



## **APPENDIX C: VENDORS INTERVIEWED**



## APPENDIX C: VENDORS INTERVIEWED

- Access Technology, Inc.
- Applied Data Research, Inc.
- Artificial Intelligence Corporation.
- Ashton-Tate.
- Boeing Computer Services.
- Business Solutions.
- Chase Decision Systems.
- Computer Language Research, Inc.
- Comshare.
- Context Management Systems.
- Cullinet Software, Inc.
- Economic Sciences.



- EPS Inc.
- Execucom Systems Corporation.
- Ferox Microsystems, Inc.
- Fox & Geller.
- Frey Associates.
- Harris.
- Human Edge Software Company.
- I.S.A.
- Lloyd Bush & Associates.
- L & L Products, Inc.
- Management Decision Systems, Inc.
- Management Sciences America, Inc.
- Manufacturers Hanover Corporation.
- Micro Data Base Systems, Inc.
- Microelectronics & Computer Technology Company.
- MicroMRP, Inc.
- Microrim.

- Officesmiths.
- Ovation Technology.
- Peat, Marwick, Mitchell & Co.
- Prime Computer.
- Ross Systems.
- SAS Institute, Inc.
- SEGRA International, Inc.
- SORCIM/IUS.
- Syntelligence.
- The MegaGroup, Inc.
- VisiCorp.
- Wang Laboratories.



## **APPENDIX D: DSS USER QUESTIONNAIRE**



## DSS USER QUESTIONNAIRE

INPUT is conducting a study of the present state and future direction of Decision Support Systems. We would like your organization to take part in this study by describing what you are doing with these systems now, what your plans are, and what problems you see. This information will be used by vendors of DSS products and services to better meet your needs. In return for your participation in this study, we will send you a summary of this study upon its completion.

The information that you provide will not be associated with your company, unless you wish otherwise.

The interview takes approximately 45 minutes to complete. Is this a good time for you to answer my questions? If not, when would be a good time to call? \_\_\_\_\_

Corporate decision makers are relying more and more on computer software tools to support the decision making process. While these software tools are referred to generically as Decision Support Systems, or DSS, defining what DSS is has proved to be a difficult task. INPUT would like you to help us better define DSS by discussing your specific needs in this area. But first I would like to get some background information about you as a decision maker.

1. Please tell me your title, department and the department function.

<u>Title</u>	<u>Department</u>	<u>Function</u>
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F001

2. Would you describe the decisions you make as being:

F002    \_\_\_\_    Operational (day-to-day) decisions

F003    \_\_\_\_    Tactical (short term) decisions

F004    \_\_\_\_    Strategic (long term) decisions



3. In the decision making process, do you make decisions:

F005        Alone, with little or no consultation with others

F006        By consensus (as part of a team)

F007        Alone, but after brainstorming with others

F008        Other (please describe)

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4. How do you see this decision making process changing over the next 2-3 years?

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5. What are the primary reasons for the changes?

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6a. Please describe the primary information that you use in the decision making process?

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6b. What is the source of this information?

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6c. How do you obtain this information?

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6d. What other departments do you interact with in the decision making process?

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6e. What other organizations, outside of your company, do you interact with in the decision making process?

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7a. Please describe what you believe a Decision Support System is or should be.

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7b. If such a Decision Support System existed to support your decision making, who would be the most likely user?

F009 \_\_\_\_\_ Yourself

F010 \_\_\_\_\_ Someone on your staff

F011 \_\_\_\_\_ Someone from the DP/MIS area

F012 \_\_\_\_\_ Other (please specify) \_\_\_\_\_

7c. Of the following functions, please rank the top 5 in terms of their importance to a Decision Support System, both currently and in 2-3 years?

<u>FUNCTION</u>	<u>CURRENT</u>	<u>IN 2-3 YEARS</u>
Data Acquisition (e.g., from corporate mainframe, external data bases, etc.)	F021	F041
Data Base Management	F022	F042
Spreadsheet	F023	F043
Modeling Language	F024	F044
Forecasting Capability	F025	F045
Financial Functions	F026	F046
Statistical Functions	F027	F047
Word Processing	F028	F048
Report Generation	F029	F049
Graphics Capability	F030	F050
Telecommunications	F031	F051

Prototyping Capability	F032	F052
Financial Consolidation	F033	F053
Transaction Processing	F034	F054
Operations Research Functions	F035	F055
Networking	F036	F056
Ergonomic Factors: (e.g., Mouse, Icons, Touch Screen, Windows)	F037	F057

8. For the 5 top functions you specified, please give me examples of how you are using or will use these functions.

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9. Do you or your company currently use DSS products/services?

\_\_\_\_\_ YES

F060

\_\_\_\_\_ NO (go to Question 12)

10. Do the Decision Support Systems you use operate on:

A.

In-house mainframe

Vendor/Hardware Model:

F061

B.

In-house minicomputer

Vendor/Hardware Model:

F062

C.

In-house personal computer

Vendor/Hardware Model:

F063

D.

External RCS

Vendor:

F064

E.

Turnkey System

Vendor:

F065

- 11a. For each product in each category above, please identify the following (reference products A, B, C, D, E, above):

<u>PRODUCT NAME</u>	<u>VENDOR</u>	<u>DATE OF FIRST USE</u>
-------------------------	---------------	------------------------------

A.

B.

C.

D.

E.

- 11b. (For respondents using more than 1 DSS product/service)  
What are the primary reasons for using more than 1 DSS  
product/service?

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- 12A. Please estimate your current annual expenditures for  
Decision Support Systems and what you expect these  
expenditures to be in 5 years?

<u>DSS EXPENDITURES</u>	<u>CURRENT (\$ THOUSANDS)</u>	<u>IN 5 YEARS (\$ THOUSANDS)</u>
Total	F070	F080
RCS Expenditures	F071	F081
Software (In-House Mainframe)	F072	F082
Software (In-House minicomputer)	F073	F083

Software (In-House  
standalone personal  
computer, e.g., IBM PC  
or PC/XT)

F074

F084

Software (In-House  
microcomputer workstation,  
e.g., IBM XT 370 or  
3270-PC)

F075

F085

Turnkey Systems

F076

F086

Hardware to Support DSS

F077

F087

12B. What are the major reasons for the increase or decrease you see in 5 years?

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13a. How many decision making applications are you currently using a DSS product/service for?

\_\_\_\_\_ F090

13b. What are the three most important decision making applications you are using, or would use a DSS product/service for, both currently and in 2-3 years?

CURRENT

IN 2-3 YEARS

1.

2.

3.



- 14a. With 1 being infrequently and 5 being very frequent, how often do you use, or would you use, DSS products/services for the following decision making tasks, both currently and in 2-3 years?

	<u>CURRENTLY</u>	<u>IN 2-3 YEARS</u>
Defining the problem	F091	F101
Collecting data	F092	F102
Analyzing data	F093	F103
Determining/evaluating possible solutions	F094	F104
Making decisions	F095	F105
Reports and presentations	F096	F106
Implementing decisions	F097	F107
Reviewing previous decisions	F098	F108
Other tasks (please specify)	F099	F109

- 15a. With 1 being little or no contribution and 5 being considerable contribution, what level of contribution is provided by (vendors) in (Defining Decision Support Applications) (Currently) and (Expected In 2-3 years)

	<u>CURRENT</u>				<u>2-3 YEARS</u>			
	D	B	U	M	D	B	U	M
Vendors (of DSS products/services used by you)	F120/F121/F122/F123				F144/F145/F146/F147			
Consultants (Including vendors of DSS products/services not currently used by you)	F124/F125/F126/F127				F148/F149/F150/F151			
DP/MIS Department	F128/F129/F130/F131				F152/F153/F154/F155			

Information Center	F132/F133/F134/F135	F156/F157/F158/F159
End User	F136/F137/F138/F139	F160/F161/F162/F163
Other (Please specify)	F140/F141/F142/F143	F164/F165/F166/F167

CODE:

D = Defining DSS Applications

B = Building DSS Applications

U = Using DSS Applications

M = Maintaining DSS Applications

16a. Does your company presently supply Information Center services?

(    ) YES                      (    ) NO (Go to Question 17) F170

16B. Please estimate what percent of your total DSS support needs are provided by the Information Center in the following areas, both currently and in 2-3 years?

	F171	F172
Software	Current ____%	In 2-3 years ____%
Nature of support?		

	F173	F174
Hardware	Current ____%	In 2-3 years ____%
Nature of support?		

	F175	F176
Data Administration	Current ____%	In 2-3 years ____%
Nature of Support?		

	F177	F178
Data Security/Integrity	Current ____%	In 2-3 years ____%
Nature of support?		

	F179	F180
Education & Training	Current ____%	In 2-3 years ____%
Nature of support?		
Other (please specify)		
	F181	F182
	Current ____%	In 2-3 years ____%
Nature of support?		

17A. With 1 representing low importance and 5 representing high importance, to accomplish your DSS applications, how important is it for personal computers to be able to access external data bases, both currently and in 2-3 years?

Current	_____	F185
In 2-3 years	_____	F186

17B. Why?

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17C. Please describe these external databases:

<u>NAME</u>	<u>TYPE</u>	<u>VENDOR</u>	<u>CURRENT/2-3 YEARS</u>
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18a. What are your plans for employing DSS products/services in the near future?

Do nothing (Go to Question 19)	F187	_____
Study	F187	_____
Probably acquire	F187	_____
Determine acquisition and appropriate dollars	F187	_____
Acquisition in progress	F187	_____

Other plans (please describe)

F187 \_\_\_\_\_

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18b. (If response to 18A is 3, 4 or 5, then ask) With 1 being unlikely and 5 being very likely, how likely is it that you will acquire or use DSS products/services in the near future that operate on the following:

	<u>PROD.</u>	<u>VENDOR</u>	<u>HARD.</u>	<u>APPR.</u>	<u>COST</u>	<u>WHEN</u>
F190	_____	In-House Mainframes				
F191	_____	In-House Minicomputers				
F192	_____	In-House Standalone Personal Computers (e.g., IBM PC or PC/XT)				
F193	_____	In-House Microcomputer Workstation (e.g., IBM XT/370 or 3270-PC)				
F194	_____	Turnkey Systems				
F195	_____	RCS Vendor				

19a. Of the following criteria, please rank the top 5 in terms of their importance in selecting a DSS product, both currently and in 2-3 years.

	<u>CURRENT</u>	<u>2-3 YEARS</u>
Vendor demonstration	F200_____	F211_____
Technical discussion with vendor	F201_____	F212_____

Sample problem for performance	F202____	F213____
Price	F203____	F214____
Comparative benchmark tests among several DSS products	F204____	F215____
Trial use period	F205____	F216____
Talk to other users	F206____	F217____
Reputation of the vendor	F207____	F218____
Vendor training	F208____	F219____
Vendor documentation	F209____	F220____
Vendor hotline support	F210	F221

- 19b. What criteria, other than those I just mentioned, do you see as being important in choosing a DSS product both currently and in 2-3 years?

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- 20a. Of the following factors, please rank the top 5 in terms of their importance in selecting a DSS product, both currently and in 2-3 years.

	<u>CURRENT</u>	<u>2-3 YEARS</u>
Provides essential tools to build your DSS application	F230____	F239____
Performs your particular DSS application	F231____	F240____
Ease of learning and use	F232____	F241____
Level of support provided by vendors	F233____	F242____
Level of in-house support available (e.g., MIS or Information Center)	F234____	F243____

Compatibility with hardware	F235_____	F244_____
Compatibility with other software packages from the same vendor	F236_____	F245_____
Compatibility with software packages from other vendors	F237_____	F246_____
Compatibility with external data bases	F238_____	F247_____
Other factors (please specify)_____		

20b. Why are these 5 factors important?

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21. What were the major reasons for selecting the DSS product you are currently using?

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22A. Who is involved in evaluating DSS products in the company (title of persons)?

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22B. Who is involved in recommending DSS products in the company (title of persons)?

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22C. Who makes the final decision to purchase DSS products in the company (title of persons)?

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22D. How long does the entire process take (from start of evaluation to final decision to purchase)?

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23. Do you have any DSS requirements that are not being addressed by currently available DSS products/services?

No        \_\_\_\_\_ (go to Question 25)        F248

Yes        \_\_\_\_\_

24. Please describe these requirements and their specific DSS applications.

REQUIREMENT

APPLICATION

(If necessary, prompt with following and get specific examples):

Planning

Marketing

Production

Data Processing

Operations

Distribution

Inventory Control

Accounting

Law

Finance

Architecture

Human Resources

Sales

Medicine

Engineering

Research & Development

25. The next set of questions relate to so called expert or knowledge based systems, which are part of the emerging field of artificial intelligence. For purposes of this study, we are defining expert systems to mean the following:

"A computer system which simulates human experts in narrowly defined problem areas." Do you agree with this definition? Yes ( ) No ( )

If "No", please tell me how you would modify it?

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- 26A. With 1 representing low importance and 5 representing high importance, how important to an expert system would you rate the following features?

Ability of the user to make requests in conversational English. \_\_\_\_\_

Ability of the system to draw conclusions. \_\_\_\_\_

Ability of the system to explain how conclusions were reached. \_\_\_\_\_

Ability of the system to recommend action steps. \_\_\_\_\_

Ability of the system to deal with incomplete input data. \_\_\_\_\_

Ability of the system to learn and gain experience. \_\_\_\_\_

26B. What other features do you feel are important to an expert system?

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26C. For each response to Question 24A of 3, 4 or 5, why is this feature important?

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27A. With 1 representing disagreement and 5 representing agreement, to what extent do you agree that "within 3 to 5 years, expert systems will be an integral part of the decision making process within your company."

\_\_\_\_\_

27B. Why?

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(If response to Question 27A is 1 or 2, go to Question 28).

27C. What specifically do you want an expert system to do for you?

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27D. What specific decision making applications do you see as being the most suitable for being developed as an expert system (get specific examples)?

(If necessary, prompt with following and get specific examples):

REQUIREMENT

APPLICATION

Planning

Marketing

Production

Data Processing

Operations

Distribution

Inventory Control

Accounting

Law

Finance

Architecture

Human Resources

Sales

Medicine

Engineering

Research & Development

27E. Why are these DSS applications suitable for being developed as expert systems?

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27F. Will you develop these applications in-house? Yes  
No \_\_\_\_

(If "no") What vendors are you aware of who could develop expert systems for you? (Then go to Question 28)

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(If "yes") Who in-house will do the development?

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Will an expert system development tool be used?

NO \_\_\_\_ YES \_\_\_\_ Which one? \_\_\_\_

Will you participate in the development of the expert system.

NO \_\_\_\_ YES \_\_\_\_

Please describe your role in the development.

28. How would you categorize the current activity in your department related to expert systems?

None \_\_\_\_\_

Researching \_\_\_\_\_

Studying \_\_\_\_\_

Planning for expert system development \_\_\_\_\_

Developing expert systems \_\_\_\_\_

Using expert systems \_\_\_\_\_

29. Are you aware of any activity in other departments related to expert systems?

No \_\_\_\_\_ Yes \_\_\_\_\_

(If Yes) please describe activity.

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Please tell me:

Department Name:

Contact:

Phone:

30. Are you aware of any vendors currently offering or developing expert systems?

No \_\_\_\_\_ Yes \_\_\_\_\_

(If Yes) please tell me:

VENDOR

PRODUCT



31. In your opinion, will expert systems supplement Decision Support Systems or will they replace Decision Support Systems?

Supplement \_\_\_\_\_

Replace \_\_\_\_\_

Why?

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32. What do you see as being the major obstacles to implementing expert systems for use in your company?

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33. In 5 years, how much do you expect to be spending on Decision Support Systems and Expert Systems?

Total \$\_\_\_\_\_ per year

What % is for DSS \_\_\_\_\_%

What % is for Expert Systems \_\_\_\_\_%

34. Are you familiar with any other users of DSS products or expert systems?

NAME

LOCATION

TELEPHONE/EXT.

35A. We have discussed only one area of Artificial Intelligence, specifically expert systems. What are your general perceptions of what Artificial Intelligence is?

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35B. What other areas of AI do you feel will grow in importance in the future?

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35C. Why will these be important?

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**Thank you for your participation.**



## **APPENDIX E: EXTENDED DSS USER QUESTIONNAIRE**



## EXTENDED DSS USER QUESTIONNAIRE

1. What is your definition of Decision Support Systems? Has this definition changed during the past few years?

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2. Does your company have an overall integrated Information Systems plan?

( ) YES ( ) NO (Go to Question 3)

- 2A. Is the IS plan integrated and developed in conjunction with a long term strategic corporate business plan?

( ) YES ( ) NO

3. Does your company have a high level senior management committee dedicated to DP/MIS developments

( ) YES ( ) NO (Go to Question 4)

- 3A. Who comprises this committee?

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- 3B. What are its functions and responsibilities?

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3C. How effective do you perceive it to be?

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4. What is your total DP/MIS budget?

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4A. What percent is this of your total operating budget?

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4B. What percent of the DP/MIS budget is for Decision Support Systems?

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4C. In what specific areas:

Remote Computing Systems	\$ _____	or	_____ %
Hardware			
- Mainframe	\$ _____	or	_____ %
- Mini	\$ _____	or	_____ %
- Micro	\$ _____	or	_____ %
Software			
- Application			
. Mainframe	\$ _____	or	_____ %
. Mini	\$ _____	or	_____ %
. Micro	\$ _____	or	_____ %
- System			
. Mainframe	\$ _____	or	_____ %
. Mini	\$ _____	or	_____ %
. Micro	\$ _____	or	_____ %
Turnkey Systems	\$ _____	or	_____ %
Professional Consulting			
- Application Development	\$ _____	or	_____ %
- Consulting	\$ _____	or	_____ %
- Training/Education	\$ _____	or	_____ %

- 4D. How do you see your dollar expenditures for DSS changing in the next 5 years?

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10 years?

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5. What hardware and software purchases do you anticipate in the next year?

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6. What DSS and/or AI tools are you currently using and for what applications?

<u>VENDOR</u>	<u>PRODUCT</u>	<u>DELIVERY MODE</u>	<u>APPLICATION</u>
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7. Do you see the mix of vendors who supply DSS products and services changing?

(    ) YES                      (    ) NO    (Go to Question 8)

7A. Who do you see as playing a prominent role in the future?

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In what areas?

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8. How long have you been using Decision Support Systems (specifically, by product and/or service)?

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9. Are there specialized DSS user groups in your company, or are your DSS products, services and facilities being used by many decision makers?

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10. What was the initial application of automated decision support within your company?

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10A. In what other areas are DSS tools being utilized?

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10B. What areas should be provided with DSS support that currently do not have it?

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11. Do you have corporate standards/guidelines concerning DSS? (i.e., mainframe vs. mini, in-house vs. RCS, tools to use/not use, how to get data, etc.?) If yes, what are they?

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12. Do you have a central data administration function? If Yes, what are its duties/responsibilities/limitations?

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13. Do you have an Information Center?

( ) YES ( ) NO (Go to Question 14)

13A. How long has it been in existence?

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13B. What is its current staffing?

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13C. What hardware and software does it have?

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13D. What is its current staffing?

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13E. Historically, how did it specifically get started and how did it subsequently evolve?

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14. What obstacles have you or are you encountering with developing Decision Support Systems?

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15. How do you perceive management in your company reacting to so called "Decision Making Systems" (i.e., in areas of Artificial Intelligence)?

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16. How quickly has your company adopted new concepts and technologies (i.e., Information Center, personal computers, etc.?)

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16A. Will you experiment with such items as Artificial Intelligence, Robotics, Vision Systems, Voice Recognition? How?

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17. Are you presently using or developing applications with AI tools, techniques, etc.?

( ) YES ( ) NO (Go to Question 18)

17A. In what specific areas?

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17B. With what tools/techniques?

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17c. Are these research or operationally oriented?

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17D. What other areas of your company do you see as being possible candidates for applications of Expert Systems or other Artificial Intelligence tools?

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18. If your company developed an industry specific "expert" system, would it consider marketing it to other firms in the same business? Why?

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19. How "user friendly" do you expect advanced Decision Support Systems/Artificial Intelligence applications to be?

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20. What role do you see consultants playing with regard to DSS?

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In particular, with regard to expert systems?

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21. Do you anticipate any problems with the proliferation of personal computers in companies? Why?

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22. What is the overall relationship between DP/MIS and the end user?

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22A. What are the relevant hardware and software procurement procedures and authorization levels?

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23. How long is your current DP/MIS backlog?

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## **APPENDIX F: USERS INTERVIEWED**



## APPENDIX F:        USERS INTERVIEWED

- Allied Chemical.
- Allis-Chalmers Corporation.
- Amdahl.
- American Air Filter.
- American Cyanamid.
- American Greetings.
- American Savings & Loan Association.
- Anheuser-Busch.
- Apple Computer.
- ARMCO.
- Ashland Oil.
- Baker International.



- Bank of Virginia.
- BASF Wyandotte Corporation.
- Bell South Corporation.
- Bethlehem Steel Corporation.
- Brockway Inc.
- Brown Foreman Distillers.
- Brown Group.
- Bucyrus-Erie.
- Butler International.
- Cameron Iron Works.
- Carpenter Technology.
- CECO.
- Central & Southwest Utilities.
- CFS Continental.
- Champion Spark Plug.
- Chemical Bank.
- CIGNA.

- Citibank.
- Clark Equipment.
- Collins & Aikman.
- Combustion Engineering.
- Cooper Tire & Rubber.
- Crocker National Bank.
- Crown Central Petroleum.
- Crown Zellerbach.
- Dairymen.
- Datapoint.
- Dillion Company.
- Dominion Bank.
- DRAVO.
- Duke Power.
- DuPont.
- Echlin.

- EG&G.
- El Paso Natural Gas.
- Federated Department Stores.
- First National Bank of Chicago.
- First National Bank of Oklahoma City.
- Fleet Financial Group.
- Ford.
- Freedom Savings & Loan.
- GATX.
- General Dynamics.
- General Foods Corporation.
- Grumman.
- HARSCO Corporation.
- Heinz, H.J.
- Hercules Inc.
- Hershey Foods Corporation.
- Hewlett-Packard.

- Hoffman-LaRoche, Inc.
- Hormel, George A.
- IC Industries.
- Internorth.
- International Minerals & Chemicals.
- Kaneb Services Inc.
- Kay Corporation.
- Kemper Corporation.
- Land O'Lakes Inc.
- Leaseway Transportation.
- Liberty National Corporation.
- Lincoln National Corporation.
- Lipton, Thomas J.
- Los Angeles Times.
- M&M Mars.
- Marriott Corporation.

- Mayflower Corporation.
- McGraw-Edison.
- Mead Corporation.
- Morgan Guaranty Trust.
- Nationwide Insurance.
- Nike Inc.
- NL Industries.
- Norstar Bancorp.
- Northern States Power Inc.
- Northwest Industries.
- Ocean Drilling & Exploration.
- Owens-Illinois.
- Pabst Brewing.
- Paccar Inc.
- Palm Beach Company.
- Penwalt Corporation.
- Ramada Inns.

- Revco D S.
- Rollins Leasing Corporation.
- Safeway Stores Inc.
- Scott & Fetzer.
- Searle G D.
- Service Merchandise Company.
- Shearson American Express.
- Society Corporation.
- Southland.
- Southwest Bancshares.
- St. Paul Companies.
- St. Regis Paper.
- Standard Oil of California.
- Standard Oil of Indiana.
- Stein Roe Farnam.
- Subaru of America.



- Sunbanks of Florida.
- Tecumseh Products.
- Tesoro Petroleum Corporation.
- Texas Commerce Bank.
- Tiger International.
- Tillinghast.
- Touche Ross & Company.
- Tracor.
- Trane Company.
- Trans World Corporation.
- Transamerica Corporation.
- Union Equity Co-op Exchange.
- Union Labor Life Insurance.
- Union Mutual Life Insurance.
- United Brands.
- United Jersey Bank.
- United Merchants & Manufacturers.

- U.S. Air.
- Vulcan Materials.
- Warner Lambert.
- West Point Pepperell.
- Wetterau Inc.
- Williams Company.
- Wisconsin Dairies Corporation.
- Woolworth.
- Yellow Freight Systems.







